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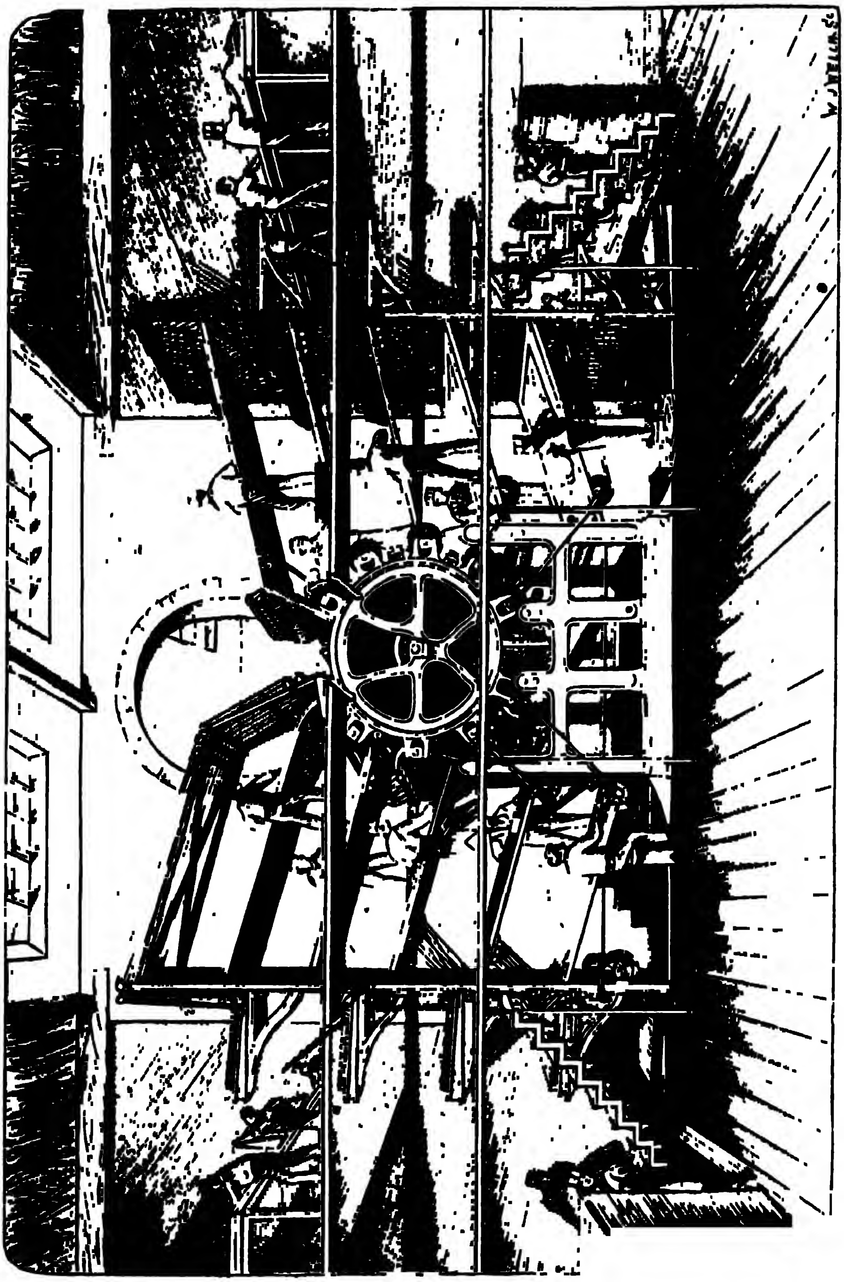

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H.

H IS the eighth letter and sixth consonant of the English alphabet. It may, however, be said to be a semivowel rather than a consonant, being pronounced merely by a forcible emission of the breath. The Greeks and Latins never, therefore, considered it as a consonant, but only as a breathing; and in the former language they had no distinct letter for it, but merely a sign. In Latin, many words were written indifferently with or without an *h*; as *arundo*, *harundo*. In those languages in which *h* is considered a consonant or pronounced hard, it is classed with the gutturals. It is a very delicate letter, and is frequently not sounded at all,—the tendency being, as a language gets softened, to make it always lighter. The Italians have almost entirely banished *h* as an independent letter out of their language. It interchanges, in different dialects, with various other letters; as with *c*, as Lat. *decem*, Ger. *zehen*; *ch*, as Gr. *chortos*, Lat. *hortos*; *g*, Lat. *digito*, Ger. *zehe*; *s*, as Gr. *hex*, Lat. *sex*; *f*, as Lat. *foris*, Fr. *hors*; *u* or *w*, as Lat. *homo*, Ital. *uomo*. H, as a Latin numeral, denotes 200, and with a dash over it 200,000.

HABAKKUK, *häb'-ă-kuk*, is the name of the thirty-fifth in order of the books of the Old Testament, forming one of those of the twelve minor prophets. The author flourished about 600 years before Christ, but little further is known regarding him. The book relates chiefly to the invasion of Judea by the Chaldeans, the overthrow of the Babylonish empire, and the final deliverance of God's faithful people. It may be divided into two parts. In the first, which is in the form of a dialogue between God and the prophet, the latter begins by deploring the desolate condition of Jerusalem (i. 1—4). God then foretells the destruction of the Jewish state by the Chaldeans (5—11). The prophet replies by expressing a hope that they may not be entirely destroyed, and that the Chaldeans may be punished (i. 12—ii. 1). God assures the prophet that the captivity will only be for a time, and that their captors will eventually be punished for their iniquities (ii. 2—20). The second part is a prayer or psalm, in which the prophet recounts the wonderful works of God to his chosen people in times past, and beseeches him to be merciful to them in their captivity (iii.). The style of this prophet has always been much admired: Eichhorn, De Wette, and Rosenmüller are loud in their praises of it, the first giving a detailed and animated analysis of the construction of his prophecies. His figures are all great, happily chosen, and properly drawn out. His denunciations are terrible, his derision bitter, his consolation cheering; while, with all the boldness and fervour of his imagination, his language is pure and his verse melodious. The famous psalm, or ode, in the third and concluding chapter, stands unsurpassed in the whole compass of Hebrew poetry, for the boldness and rapidity of its flights, the sublimity and grasp of its conceptions, the magnificence of its imagery, the music and melody of its rhythm. "He contends," says Eichhorn, "with words, he struggles with images; and who is not seized with a sacred shudder as he reads, like that of the prophet himself, as he beheld the sublime and terrible appearance of the indescribable." The canonical authority of this book has never been called in question; and it is several times quoted in the New Testament.

HABEAS CORPUS, *hai'-be-ăs kor'-pus* (Lat., that you (the person to whom this writ is directed) have the body of), in Law, is the name of a writ, of which there are several kinds; but the great writ of that name is the *habeas corpus ad subjiciendum*, which, in the case of alleged illegal confinement, is directed to the person detaining, and calls upon him to produce the body of his prisoner, and state the cause of his detention, and receive the award of the judge or court. The personal liberty of the subject has always been regarded by the law of England as a constitutional right, unless forfeited by the commission of some great and atrocious crime. This doctrine has been handed down to us from Saxon times, and though sometimes assailed by the despotism of jealous or usurping princes, it still continued to maintain its ground, and was established on the firmest basis by the provisions of the Magna Charta, and a long succession of statutes enacted under Edward III. It is this which induces the absolute necessity of expressing upon every commitment the reason for which it is made, that the court may, upon a habeas corpus, examine into its validity, and, according to the circumstances of the case, discharge, admit to bail, or remand the prisoner. Yet in the early part of the reign of Charles I. the court of King's Bench held that they could not either bail or deliver a prisoner upon a habeas corpus, though committed without any cause assigned, if committed by the special command of the king, or by the lords of the privy council. This caused a parliamentary inquiry, and produced the Petition of Right, which recites this judgment, and enacts that no freeman hereafter shall be so imprisoned or detained. The court, however, still endeavoured to uphold the prerogative of the crown, and in consequence, the statute 16 Car. I. c. 10, was extorted by the parliament, which enacts that any person committed by the king himself in person, or by his privy council, or any of the members thereof, shall have granted unto him a writ of habeas corpus, upon demand or motion made to the court of King's Bench or Common Pleas, who shall thereupon, within three days after the return is made, examine and determine the legality of such commitment, and do what to justice shall appertain. Still means were adopted to evade this law, until at length the statute 31 Car. II. c. 2, was passed, called the Habeas Corpus Act, which is frequently regarded as another Magna Charta. It provides, that on complaint and request in writing, by or on behalf of any person committed or charged with any crimes (with certain exceptions, as in treason or felony, expressed in the warrant), the lord chancellor, or any of the twelve judges in vacation, shall award a habeas corpus for such prisoner, returnable immediately before himself or any of the other judges; the writ to be returned, and the prisoner brought up, within a limited time, according to the distance, not exceeding in any case twenty days. It has been usual in times of danger to suspend the Habeas Corpus Act; but this can only be done by an act of parliament authorizing the Crown for a certain period to imprison suspected persons without assigning cause for so doing. As this act extended only to per-

sons committed on criminal charges, all other cases of unjust imprisonment being left to the operation of the common law, the statute 56 Geo. III. c 100, was passed, which declares that a writ of habeas corpus returnable immediately may be issued to bring up the body of any person restrained of his liberty (other than for some criminal matter), except persons imprisoned for debt, or by process in a civil suit. There are various other kinds of writs of this name made use of by the courts of Westminster for removing prisoners from one court into another for the more easy administration of justice; as the *habeas corpus ad respondendum*, when a man has a cause of action against one who is confined by the process of some inferior court, in order to remove and charge him with this new action in the court above; *ad satisfaciendum*, when a prisoner has had judgment against him in an action, and the plaintiff is desirous to bring him up to some superior court, to charge him with process of execution.

HABENDUM, *hab-en'-dum*, in Law, is the name of a clause in a deed of grant or lease, in which is described the estate or interest granted by the deed.

HABERE FACIAS POSSESSIONEM, *ha-be'-re fa'-she-as poz-zes-she-o'-nem* (Lat., you may cause to have possession), in Law, is a writ of execution granted to a plaintiff who has obtained judgment in an action of ejectment, whereby the possession of land is awarded to him. It is directed to the sheriff of the county, commanding him to give actual possession to the plaintiff of the land so received; in the execution of which the sheriff is justified in breaking open doors, if necessary, and then delivering over possession to the plaintiff.

HABIT. (*See* CUSTOM AND HABIT.)

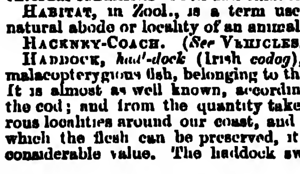
HABIT AND REPUTE, *hab'-it, re-pute'* (Ang.-Nor.), a phrase in Scots Law, denoting something well known or generally received. Where a man and woman cohabit as husband and wife, and are generally reputed to be married, this by itself is held by the law of Scotland to constitute marriage, and evidence to the contrary will be of no avail. A habit and repute thief is one who is notoriously such, and this forms an aggravation of the offence, *nominally* rendering it capital, and therefore not bailable.

HABITAT, *hab'-e-tat* (from Lat. *habito*, I dwell), in Bot., the country or district in which a plant grows wild; the tract or range to which it seems limited by external conditions of soil and climate.

HABITAT, in Zool., is a term used to express the natural abode or locality of an animal.

HACKNEY-COACH. (*See* VEHICLES.)

HADDOCK, *had'-dock* (Irish *codog*), a sub-brachial malacopterygious fish, belonging to the family *Gadidæ*. It is almost as well known, according to Yarrell, as the cod; and from the quantity taken of it at numerous localities around our coast, and the facility with which the flesh can be preserved, it is a fish of some considerable value. The haddock swims in immense shoals, which are in the habit of entirely changing their stations when they visit our coast: they are more abundant from Yarmouth to the Tyne, however, than elsewhere.



HADDOCK.

They are caught with long lines and hand-lines, and their favourite bait is a herring. The common weight of the fish is about from two to four pounds, although there have been several instances of some weighing as much as ten pounds being seen in the London market. It is said that the haddock is the *asinus*, or *onos*, of the ancients; and there is a superstition which ascribes the dark stripes over the shoulders of this fish to the impression left by St. Peter when he took the tribute-money out of the mouth of one of its species: unfortunately, however, for this superstition, the haddock does not exist in the Sea of Galilee, which is fresh water. The length of the haddock is generally about twenty inches. The body is lance-shape, and the head slopes suddenly from the crown to the point of the nose, which latter projects be[yond] the mouth. The colour is throughout a dullish g[rey] with the exception of the belly, which is white.

HADJI, *had'-je* (Arab., a pilgrim), is the title [of a] Mohammedan who has performed a pilgrimage [to] Mecca, a religious act which every true believ[er is] bound to perform at least once in his life; but min[ors,] slaves, and lunatics are exempt from this obligat[ion.] *Hadj* is the name of the celebration which takes p[lace] on the arrival of the caravans of pilgrims at Me[cca,] and a Mohammedan who has made the pilgrim[age] commonly bears for the rest of his life the titl[e of] *hadji* prefixed to his name. As is well known, [pre]sence at these ceremonials is strictly prohibited t[o all] but the faithful, but at least five European Christ[ians] are known to have been present at these ceremon[ials,] the two last of these were the celebrated travel[lers] Burckhardt (in 1814) and R. F. Burton (in 1853), b[oth] of whom have published interesting accounts of t[heir] journeys.—*Ref.* Burckhardt's *Travels in Arabia*, 18[29]; Burton's *Personal Narrative of a Pilgrimage to Medinah and Mecca*, 3 vols London, 1856.

HÆMANTHUS, *he-man'-thus* (Gr. *haima*, blood; *ant[hos]* flower), in Bot., a gen. of the nat. ord. *Amaryllida[ceæ]*. The juice of *H. toxicarius* is extremely poisonous, [and] is used by the Hottentots to poison their arrow-he[ads.]

HÆMATEIN, *he'-ma-teen*, in Chem.—If hæmatox[ylin] be dissolved in water, and ammonia added to the s[olu]tion, a purple liquid is formed, from which hæmat[ein] may be precipitated by acetic acid as a reddish-br[own] powder. It is sparingly soluble in cold water, somewhat more so in hot, from which it crystallize[s in] [illegible] masses. It must not be confoun[ded with] [illegible]

HÆMATEMESIS, *he-ma-tem'-e-sis* (Gr. *haima*, bl[ood;] [a]nd *emesis*, a vomiting), in Med., is the vomitin[g of] [b]lood from the stomach. An individual, previou[sly] perhaps, to appearance, in robust health, after s[ome] strong mental emotion or physical exertion, is sudde[nly] seized with a sense of fulness of the stomach and s[ick]ness, when he speedily ejects by vomiting a quantity [of] blood. The attack is usually preceded by various p[re]monitory symptoms; as loss of appetite, indigesti[on,] nausea, uneasiness or pain in the epigastric region, [&c.] The blood proceeding from the stomach is to be [dis]tinguished from that coming from the lungs, and [may] be known by its [illegible] of a dark colo[ur,] while that proceeding [illegible] generally bri[ght] and florid. Hæmatemesis may exist and yet no b[lood] be ejected; for it may come in small quantities and p[ass] through the alimentary canal; it may also proce[ed] from the [illegible], mouth, or nostrils. It may result fr[om] various causes; as (1), it may be idiopathic, (2), [it] may be vicarious of some other habitual hæmorrhag[e;] (3), it may depend upon disease or injury of t[he] stomach itself; (4), it may be the consequence [of] disease situate elsewhere, and producing mechanica[l] a plethora of the veins of the stomach; (5), it m[ay] result from a morbid condition of the blood, and fo[rm] one symptom of a more general disease. The mode [of] treatment will necessarily vary in particular cases; [in] general, every effort is to be made to tranquillize t[he] circulation, and to arrest the hæmorrhage; for whi[ch] purpose ice taken into the stomach is often very ben[e]ficial the acetate of lead, in combination with opiu[m,] may also be given. All irritating substances should [be] avoided, and whatever nourishment is taken into t[he] stomach should be in the form of cold liquids. This [is] a disease which is often feigned by impostors swallo[w]ing blood and afterwards vomiting it.

HÆMATIN, *he'-ma-tin* (from Gr. *haima*, blood), t[he] true colouring principle of the blood, from which it [is] obtained by a very difficult process.

HÆMATITE, or HEMATITE, *he'-ma-tite* (from G[r.] *haima*, blood), one of the most important iron or[es.] There are two kinds of hæmatite,—the red, which [is] an anhydrous peroxide of iron, and the brown, whi[ch] is the peroxide in a state of hydration. A full d[e]scription of these important ores will be found und[er] IRON ORES.

HÆMATOIDIN, *hem-a-toy'-din* (from Gr. *haima*, blood), a crystalline body (an oblique rhombic prism), of bright orange-red colour, formed in blood which h[as] been effused into the tissue of a live animal. It [is] soluble in ammonia.

Hæmatoxylon, *he-mă-toks'-e-lon* (Gr. *haima*, blood; *xulon*, wood), in Bot., a gen. of the nat. ord. *Leguminosæ*, sub-ord. *Cæsalpinæ*. The species *H. campechianum* is a shrub of sub-tropical America. The wood, commonly known under the name of *logwood*, is employed in dyeing. Powdered logwood is mixed with sand and digested for several days in pure ether. The deposit is filtered and evaporated until it forms a syrup, when it is set aside to crystallize. In a few days hæmatoxylon is deposited in straw-yellow crystals, which form a solution that assumes a brilliant red colour under the influence of alkalies or oxygen. It is also an astringent and tonic in medicine. It contains crystalline colouring principles called *hæmatin* and *hæmatoxylin*.

Hæmatozoa, *he-mă-to-zo'-ă* (Gr. *haima*, blood; *zoön*, a living being), a term applied to the animalcules, or entozoa, which exist in the blood of mammals, birds, reptiles, fishes, and many invertebrate animals. They are generally microscopic, without generative organs, and found existing in the blood circulating both in the arteries and veins. A very small proportion attain a large size and have organs of reproduction; these are generally found in some special part of the body. Thus the variety called *Distoma hæmatobium* is only found in the abdominal venous system; another variety is found restricted to the abdominal arterial system of the horse; and the *Pseudalius filum* is only found in the pulmonary artery and branches of the porpoise. Very little is known concerning the origin of these entozoa. It seems probable that some of the minute forms are the larvæ of a worm living in the organs surrounding the vessels. The most important of the human hæmatozoa is the variety mentioned above: it has only been observed in Egypt. The liver-fluke (*Distoma hepaticum*) has sometimes been found in the interior of the portal vein. Those hæmatozoa which have been found in tumours must have been conveyed there by the blood. Horses and dogs are frequently affected with these parasites; in the case of the latter animal, they are seldom large enough to be visible to the naked eye. The presence of hæmatozoa does not, however, seem to affect the general health of either men or the other animals.

Hæmodoraceæ, *he-mo-do-rai'-se-e* (Gr. *haima*, blood), in Bot., the Blood-root fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*, consisting of herbs or rarely shrubby plants, with fibrous roots and ensiform leaves. Perianth superior, tubular, 6-parted, regular, the divisions being usually scurfy or woolly on the outside; 3—6 stamens, having introrse anthers, and an inferior ovary, 1—3-celled. Natives of America, the Cape of Good Hope, and Australia. The roots of several species of the typical genus *Hæmodorum* are roasted and eaten by the natives of certain parts of Australia. They contain a red colouring matter. The blood-red root of *Lachnanthes tinctoria*, a plant of this order, is used for dyeing in North America.

Hæmoptysis, *he-mop'-te-sis* (Gr. *haima*, blood, and *ptusis*, spitting), in Med., denotes in general the spitting of blood, and is generally used by pathologists to signify the expectoration of blood from the lungs and air-tubes. It is important to ascertain the source of the blood which escapes from the mouth, and, if determined to be from the lungs, to ascertain whether it is symptomatic of disease of these organs, or merely vicarious in its character. It is not so much dangerous in itself as an indication of some other dangerous disease, being most frequently connected with tubercular consumption. Bleeding from the lungs may occur without organic disease in plethoric and robust individuals living a life of excitement and excess, and in nervous, irritable individuals weakened by mental or bodily fatigue, and leading sedentary lives. It is often hereditary, and may be brought on by violent muscular effort, paroxysms of cough, blows or pressure on the chest, inspiration of irritating vapours, or of rarefied air on high mountains. The blood may be exuded from the tracheal or bronchial membranes, or it may proceed from capillaries communicating with the air-passages in any part of their extent. The amount varies from a drachm or two to as many pints at a time, and is generally florid, and more or less mixed with air, differing from the dark, coagulated blood which comes from the stomach. An attack is frequently announced by a feeling of heat and oppressi[on] in the chest behind the sternum, followed by a coug[h] which brings up the blood. When the quantity is ve[ry] great, it pours forth without cough, and almost by [an] act of vomiting, with considerable spasmodic effo[rt]. In all such cases, it is best to seek medical advice [as] early as possible. Among the agents that are usef[ul] in arresting hæmoptysis, may be noticed the essen[ce] of turpentine, 10 to 30 drops in a glass of wat[er;] tannin or gallic acid. Nauseating medicines, as tart[ar] emetic and ipecacuanha, are also frequently employe[d]. Common salt, in a dose of from 60 to 120 grains, is [an] excellent popular remedy. In all cases, calmness [of] mind, rest, silence, erect position, cool air, and fre[e]ness of the bowels, should be enjoined. When t[he] attack proceeds from congestion, bloodletting is r[e]commended in certain cases. If cough be present, [it] should be allayed by narcotics. After the attac[k] astringent tonics, as iron and quinine, may be give[n], and the return of the bleeding is to be guarded again[st] by avoiding the exciting causes, and attending to t[he] rules of health.

Hæmorrhage, *he'-mor-raij* (Gr. *haima*, blood, a[nd] *rhegnumi*, I break or burst), in Med., is an esca[pe] of blood from some of the vessels of the body. T[he] most common cause of hæmorrhage is external violenc[e] by which the blood-vessels of a part are divided. Wh[en] an artery of some size is thus injured, a continuou[s] stream of bright red blood is projected with a for[ce] proportioned to the size of the vessel, and with a motio[n] corresponding with the pulsations of the heart. If [a] vein, on the other hand, be injured, the blood is of [a] dark crimson colour, and the flow is continuous an[d] equable, with much less force than from an arter[y]. Where merely a number of capillaries are injured, th[e] blood flows in a more or less rapid oozing from th[e] wound, but without being projected to any distanc[e] from the body. When a large artery is cut, the blee[d]ing is so excessive as to cause almost instant deat[h]. If of smaller size, fainting is usually, after a time, pr[o]duced by loss of blood, and, the heart ceasing i[ts] action, the blood coagulates about the wound, an[d] thus stops it up. Frequently the returning action [of] the heart forces away the obstruction, and the bloo[d] flows afresh; and in this way, if not attended to, th[e] patient may perish from exhaustion. With arteries o[f] smaller size, the flow of blood is at first rapid, bu[t] after a few minutes, with exposure to the air, the ori[]fice contracts, the blood coagulates, and the bleedin[g] ceases, without much danger of returning. Hæmor[]rhage from wounded veins is much less dangerous, a[s] the blood flows with much less violence, and the edge[s] of the vessels tend more to come together. Henc[e] bleeding from a vein is seldom immediately fatal[.] When blood gushes out from internal parts, throug[h] any of the natural apertures of the body, the perso[n] is commonly said to have "burst a blood-vessel." Thi[s], however, is very rarely the case. If there be any rup[]ture, it is usually only of the minute capillaries; bu[t] even of this there is often no palpable evidence. Bloo[d] may exude abundantly from a surface which presents, t[o] the naked eye at least, no appreciable injury or change. There are even well-authenticated instances on recor[d] of cutaneous hæmorrhage, where a dew of blood ha[s] appeared upon some portion of the skin, and been wiped away, and reappeared again and again, without any discernible change of the affected surface, beyond some occasional variation of its colour. There are also what are termed "habitual hæmorrhages," as from the nostrils, &c., which take place periodically with certain individuals, and belong to the original constitution of the body, and can scarcely be regarded as disease. Again, there are certain forms of hemorrhage not habitual, which may be denominated idiopathic, inasmuch as they are apt to arise without any perceptible connection with antecedent local disease. In other respects they differ considerably, and are distinguished as active and passive, the former being preceded by active congestion, and therefore akin to inflammation; the latter often occurring without any apparent previous congestion of any kind. Passive hæmorrhage derives its name from being ascribed to some change in the condition of the blood-vessels themselves, by which their textures become relaxed and debilitated; but more probably it arises from some altera-

tion in the condition and consistence of the blood itself, which becomes attenuated. Active hæmorrhage occurs principally in persons who are young and robust, who live well and lead indolent lives; and is, for the most part, to be regarded as an effort of nature to cure itself. It is followed by morbid consequences only when the quantity has been excessive, or when it inflicts some mechanical injury upon the parts along which the blood passes. Hence it is frequently improper to employ any direct means of stopping the flow of blood; but much will depend upon the circumstances of each particular case. As they are akin to inflammation, the treatment of inflammation may often be requisite. In all severe cases, the antiphlogistic regimen should be strictly enjoined. The patient must be kept in a state of absolute quiet; all motion of the body and emotion of the mind; all kinds of stimulating food and drink, should be carefully avoided; and the patient surrounded, as much as possible, by cool fresh air. Sometimes, as in inflammation, it is necessary to have recourse to venesection, in order to divert the current of blood from the suffering organ. Mercury is an important remedy for inward bleedings. Cold is also a valuable remedial agent, placed either in direct contact with the bleeding surface, or as near as possible to it. Acetate of lead, and the various vegetable compounds of gallic acid, are important astringent remedies in such cases. When a large artery is wounded, it is generally necessary to pass a ligature round it, above and below the wound.—*Ref.* Watson's *Principles and Practice of Physic; English Cyclopædia*,—Arts and Sciences.

HÆMORRHOIDS, or PILES, *he'-mor-roydz* (Gr. *haima* and *rheo*, I flow), is a disease of the rectum and anus, accompanied or followed by tumours in those parts, or by a flow of blood from them when the patient is at stool, recurring after intervals, and sometimes periodically. It is usual to apply the term either to a simple bleeding from the veins of the lower part of the rectum, recurring more or less frequently, yet not accompanied with any distinguishable tumours, either within or on the outside of the anus; or else swellings formed by a varicose distension and morbid thickening of those vessels, either with or without occasional hæmorrhage; or, lastly, tumours originally produced by effused blood, but subsequently converted into an organized substance. They are distinguished into external and internal piles, according as they are situated outside of or within the anus; and into *blind*, or such as do not bleed; and *open*, or such as are subject to occasional hæmorrhage. The tumours vary greatly in size and form, some of them being hardly as large as a pea, others as large as a walnut or apple. They are sometimes attended with great pain, so that the patient can neither sit nor walk, with generally more or less fever and restlessness. Sometimes the patient's strength is greatly reduced by discharges of blood or seropurulent matter; or inflammation of the neighbouring parts may be induced, causing abscesses, fistulæ, &c. Generally, however, the disease is of a less severe nature. It may be caused by anything which is capable of retarding the return of blood through the hæmorrhoidal veins. The pressure of the graved uterus, costiveness, and the frequent retention of hardened fæces in the rectum, are frequent causes. Persons of sedentary habits are often troubled with this disease. In its treatment it is of importance that the bowels be kept open by gentle laxative medicines, as castor oil; and great benefit will often be derived from the application of warm water to the part, or from sitting over a steam of warm water when at stool. An ointment composed of equal parts of the powder of oak-galls and hog's-lard, and applied to the part, is usually of great service. The application of leeches to the part is also recommended, if the disease be in a state of inflammation. Where all other remedies fail, it is often necessary to have recourse to an operation; but this should only be in very severe cases, as it is not unattended with danger. This is done either by cutting off the tumours with a pair of scissors or knife, or by applying a tight ligature round their base, so as to cause them to slough away.—*Ref.* Cooper's *Surgical Dictionary;* Copland's *Dictionary of Medicine.*

HÆREDITAS JACENS, *he-red'-e-tas jai'-sens*, in Scots Law, is a term applied to the estate of a deceased person, not taken up by his heir. A creditor attaches it by charging the heir to enter, and, on his renouncing, obtaining a constitution of his debt, and an adjudication of the estate.

HÆRETICO COMBURENDO, *he-ret'-e-ko kom-bu-ren'-do*, is the name of a writ which anciently lay against a heretic who, having once been convicted of heresy, and abjured it afterwards, fell into it again, and was in consequence handed over to the secular power.

HAGGAI, *hăg'-gai*, is the name of one of the prophetic books of the Old Testament, whose author, Haggai, flourished during the reign of Darius Hystaspes, about five hundred years before Christ. He is classed among what are usually termed the minor prophets. His book comprises four discourses, of which, in all probability, we have only an epitome, and which are all concerning the same subject,—the building of the temple. In the first he reproves the indifference of the people respecting the building of the temple, assigning that as the reason why they are punished with great drought and unproductive harvests; and exhorts them to undertake the work, encouraging them with the promise of divine aid (i.). The second brief discourse consists of a consolatory promise, that the glory of the second temple shall surpass that of the first (ii. 1—9). The third censures the outward and legal righteousness prevailing among the people, by means of which they were deprived of the divine blessing (ii. 10—19). The fourth contains a promise of the future glorification awaiting the royal offspring of David and Zerubbabel, after the downfall of all earthly thrones. The style of Haggai in reproving is indeed vehement, but by no means poetic. In general, it is flat and destitute of power, though there are passages, where he treats of future events, in which he becomes somewhat elevated. There is also a marked poverty of language, as may be observed in the frequent repetition of the same expressions.

HAGIOGRAPHA, *hăg-e-og'-re-fă* (Gr., sacred writings), is a term sometimes applied to certain books of the Old Testament. The Jews divided the books of the Old Testament into—1. the Law, comprehending the five books of Moses; 2. the Prophets; and 3. the

[illegible]

[illegible]glish language.

inspired in a lower degree than the others; but they did not always agree as to what books belonged to the second, and what to the third class. With us, the Hagiographa comprise the books of Psalms, Proverbs, Job, Song of Solomon, Ruth, Lamentations, Ecclesiastes, Esther, Daniel, Ezra, Nehemiah, and the Chronicles.

HAIL, *hail* (Sax. *hægel*), drops of rain converted into pellets of ice, by a great and sudden reduction in the temperature of the region in which these raindrops have been forming, by means of the gradual condensation of the watery vapour of the atmosphere. A very cold current of air acting suddenly on vapour which has not quite attained that condition from which it would pass rapidly into the form of drops of rain, would cause the vapour to freeze, and fall to the ground as snow; but supposing that this vapour had just reached that point of saturation and condensation at which it would assume the form of rain, and was on the point of falling in that shape, the action of intensely cold air would cause it to turn into globules of ice in its descent, and reach the earth in that state. The formation of hail, therefore, may be considered to be the consequence of the sudden influence of a very cold current of air on a mass of vapour at rest, and nearly approaching that state of saturation which immediately precedes its conversion into rain. Hailstorms are always attended with wind, and are usually followed by a heavy fall of rain. The barometer also falls suddenly to a considerable extent immediately before a hailstorm, which is frequently accompanied by thunder and lightning. Showers of hail are of short duration, very seldom lasting as long as a quarter of an hour. The clouds from which hailstones fall are considered to be of great extent and depth, on account of the great obscurity which they produce. They are generally of a reddish-grey colour, with protuberances swelling out from the under surface, and deeply indented edges. Hailstorms are generally confined to a limited area, although they are

occasionally known to sweep across the face of country in a long narrow track, as in the hailstorm which passed over France in 1788. This remarkable storm of hail traversed the land from south to north in two parallel tracks about 600 miles long, and from 6 to 12 miles broad, separated by an intermediate track 15 miles wide, over which there was a heavy fall of rain, but no hail. Hailstones vary considerably in weight and size. In England they have been seldom known to exceed an inch in diameter; but they are, for the most part, about the size of a small pea. It is, however, on record, that hailstones have fallen in this country as large as eggs, and even as much as three inches in diameter; while in Suffolk, in a hailstorm which took place August 3, 1824, the hailstones were large enough, and fell with sufficient velocity, to kill game and domestic fowls. In India they are commonly as large as pigeons' eggs, and frequently three or four inches in diameter, weighing as much as a pound; and some have been picked up as large as a water-melon, and as much as fourteen pounds in weight. Hailstorms have frequently caused great damage to the grain crops in various parts of England. From the chronological lists of hailstorms during the present century that have been already published, it appears that they are of most frequent occurrence in the months of June and July. Agriculturists can indemnify themselves from loss and injury to their crops from hail, by insuring themselves against its calamitous effects in the Royal Farmers' and General Insurance Institution, and similar assurance societies. The necessity of this is fully apparent, when it is stated that, in 1824, the corn crops on about 3,500 acres of ground in Hertfordshire, Middlesex, and Essex, sustained damage to the average extent of £1 per acre, and that it has been found that hailstorms have been of more frequent occurrence in later years than formerly.—*Ref.* Brande's *Dictionary*,—art. Hail; *Encyclopædia Britannica*,—art. Meteorology; Howard's *Climate of London*; Thomson's *Introduction to Meteorology*.

HAIMATURIA, *hai-mâ-tu'-re-a* (Gr. *haima*, blood, and *ouron*, urine), in Med., is bloody urine, a discharge of blood with the urine, owing usually to a diseased state of the kidneys or bladder. It is usually a symptom of some other disease, upon the nature of which its treatment in general depends.

HAIR, *hair* (Sax. *hær*, Ger. *haar*), in Anat., is applied to the small cylindrical, transparent, insensible, and elastic filaments which arise from the skin, and are attached to it by means of small roots. Hair is found to grow on all parts of the surface of the human body except the palms of the hands and the soles of the feet. Hair, being a bad conductor of heat, serves to keep the surface of the body warm, as well as to protect it from the influence of external heat, moisture, and electricity: it thus performs an important part in the animal economy. Hair differs considerably in length, [illegible] [illegible] breasts, &c., of men; and short, which exists over most other parts of the body, and is much softer than the other. A hair is composed of two parts,—a shaft and a bulb, the former being that part which rises above the surface of the skin, the latter that which is inserted in the skin. The bulb is inserted in a follicle in the cutis or true skin, the follicle being, like the hair which is inside of it, bulbous, or larger at the lower part. The hair grows from the bottom of the follicle, being formed by the secretions of cells which line the sides of the follicles. Hair is composed of an outer cortical, fibrous or horny substance, which invests it, and an inner medullary or pith-like substance within. The cortex or bark of the hair is composed of a single layer of cells, which overlap each other and give a serrated appearance to the hair when seen under the microscope. The central portion is made up of a series of cells filled with pigment. The colour of the hair seems to depend on the presence of a peculiar oil, which is of a blackish-green colour in dark hair, blood-red in red hair, and nearly colourless in white hair. The grey hair which attends old age is the result of a deficient supply of pigment. Well-authenticated cases are given even of young persons whose hair has become grey even in a single night, in consequence of some strong mental excitement; as fear, sorrow, &c. Various attempts have been made to explain this phenomenon, but no satisfactory solution of the difficulty has been arrived at. Some races and persons are noted for the length and luxuriance of their hair, while in others it is very deficient. In some races, as the Kurilian, it grows nearly the length of the whole body. (*See also* BEARD.)

HAIR MANUFACTURE, the manufacture of certain articles with human hair and the hair of certain quadrupeds, upon which a considerable amount of industry is bestowed. Some of the articles made, depend upon the felting properties of a few kinds of hair, others upon the strength of the fibre, and others upon the fine gloss of which it is susceptible. The trade in human hair is very considerable, and much more important than would ordinarily be believed. A very large quantity is imported into London every year, principally for the purpose of making wigs, perukes, and false curls, &c., for ladies. According to a German who has studied the statistics of the hair trade, every adult female head contains an average number of 110,000 hairs, the blonde being the most numerous, and the red fewer and coarser. The light hair imported into this country nearly all comes from Germany, and the dark hair from France. In England, sometimes young girls with beautiful hair are urged by poverty to sell their tresses; but in France they make it a regular business. In Paris there are hair-merchants, who despatch agents into the country every spring to purchase the hair from young women. They attend the fairs, and carry with them a large stock of ribbons, handkerchiefs, &c., which they give in exchange for the hair. The young women cultivate their crops of hair with great care, and sell the result of their harvest to the best bidder. It is estimated that 200,000 lbs. of hair are purchased every spring, the usual price averaging five francs per lb. The hair is then sent by the agents to their employers, who, after dressing and sorting it, sell it to the hair-workers. Besides wigs, perukes, false curls, &c., hair is much used in making hair jewellery; for this kind of work the ordinary clippings are sufficient. The hair goes through numerous small manipulations, and is cleaned and curled according to the nature of the ornament it is intended for. The hair of the head often grows to a great length; in the Hair court of the International Exhibition of 1862, a specimen of jet-black hair was exhibited measuring seventy-four inches in length. Next to human hair-manufacture comes that of horsehair. The fabrics made with this substance are woven by the workman with a hook-shuttle, which he passes under the threads of the warp from right to left; an assistant places a single hair over the end of the hook, and the weaver draws it through the warp. The process is very tedious. Twenty thousand hundredweight of horse-hair are imported annually, and half a million yards of horse-hair cloth are annually exported.

HAIRS, in Bot. (*See* EPIDERMAL APPENDAGES.)

HAKE, *haik* (Ang.-Sax.), *Merlucius vulgaris* of Cuvier, a species of fish belonging to the *Gadidæ* or Cod family. Its generic characters are, head flattened; body elongated; the back furnished with two dorsal fins, the first short and the second long; one anal fin, and no barbule at the chin. It inhabits the seas of north Europe and the Mediterranean, and, although somewhat scarce off the coast of Scotland, it is found most abundantly along the southern coast of England, Portsmouth receiving the greatest supply of this fish. Yarrell, in his "History of British Fishes," states that the hake may be traced nearly all round the coast of Ireland; and it is so abundant in the Bay of Galway, that, according to a recent writer, this bay is named in some ancient maps the *Bay of Hakes*. On that part of the Nymph Bank off the coast of Waterford, this fish is also so plentiful that 1,000 have been taken by six men in one night. It is a voracious fish, as its systematic name of *Merlucius*, sea-pike, implies. It is a coarse fish, not admitted to the tables of the wealthy; but large quantities are annually preserved both by salting and drying, part of which is exported to Spain." The colour of the hake is a dusky brown on the upper part of the body, with a lighter shade of the same colour below; the dorsal and caudal fins dark, and the ventral and anal fins pale brown.

HAKLUYT SOCIETY, *häk'-luit*, the name of a society formed in the year 1846, for the purpose of printing in English, for distribution among its members, rare and valuable voyages, travels, and geographical records, including the more important early narratives of British enterprise. This society was named after the celebrated old English geographer and historian, Richard Hakluyt, or Hackluyt; and at a meeting held on the 15th December, 1846, at 12, St. James's Square, Sir Roderick I. Murchison being in the chair, the following resolutions were carried:—"That a society, to be called the Hakluyt Society, be formed, for the purpose of printing, for distribution amongst its members, the most rare and valuable voyages, travels, and geographical records, from an early period of exploratory enterprise to the circumnavigation of Dampier." 2nd. "That the annual subscription be one guinea, payable on the 1st January; and that each subscriber be entitled to receive, without further charge, a copy of every work produced by the society within the year subscribed for." The number of members is about 300.

HALBERT, or HALBERD, *häl'-bert* (Fr. *hallebarde*), an offensive weapon consisting of a shaft about five feet long, made of oak, having a steel head formed somewhat like a crescent. It was much used formerly, but is seldom or ever now seen, except in some Scotch boroughs, where it is employed by the civil officers who attend the magistrates in processions and on other public occasions.

HALCYONIDÆ. (*See* ALCEDO.)

HALCYON DAYS, *häl'-se-on*, was a term applied by the ancients to the seven days which immediately precede and follow the shortest day, from the circumstance that the halcyon or kingfisher selected that period for incubation, and they believed that, on that account, the weather was always remarkably quiet about that time. Hence the phrase "halcyon days" has passed into a proverb, as denoting times of peace and tranquillity.

HALF-BLOOD, *half'-blood* (Sax. *half*), in Law, is used to denote persons having only one parent in common: when they have both parents in common, they are whole blood. When the common parent is the father, they are brothers or sisters consanguinean; when the mother, uterine. In the succession to real or landed property in England, a kinsman of the half-blood inherits next after a kinsman of the whole blood in the same degree, and after the issue of such kinsman, when the common ancestor is a male, but next after the common ancestor, when such ancestor is a female. So that brothers consanguinean inherit next after the sisters of the whole blood and their issue, and brothers uterine next after the mother. In Scotland, however, only the half-blood consanguinean succeed after the full blood; the half-blood uterine never succeed in any event. In England, as regards personal estate, a brother or sister of the half-blood, whether by the mother or father's side, shares equally with the whole blood, for they are both regarded as equally near of kin to the deceased. In Scotland, however, brothers and sisters german and their issue first take, exclusively; then brothers and sisters consanguinean and their issue, exclusively; and then brothers and sisters uterine and their issue.—*Ref.* Paterson's *Compendium of English and Scotch Law*, 1860.

HALF-PAY, a term applied in the English army and navy to an allowance given to commissioned officers who are not actively employed. When an officer joins the army, he is posted to a particular regiment, with which he is supposed to serve until removed, on gaining the rank of general. Superannuated officers attain by long service retired full pay, and half-pay is granted temporarily only to officers thrown out of employment by the reduction of the corps, or to those who are compelled by sickness to leave active service. Except [illegible] some other to exchange with him; but this exchange can only be made when the probabilities of each officer's life are equal. The charge for half-pay, although reduced every year, is very large; in 1862 it amounted to £360,000. The first army-grant for half-pay was made by William III., in 1698. When a regimental officer receives a superior appointment on the staff, he is placed on temporary half-pay. In the navy, the arrangements for half-pay are very different. All officers are appointed merely to serve during the time while a certain ship is in commission; when this expires, their employment ceases, and they leave active service. As there are more naval officers than there are appointments to fill up, there is always a large number on the non-effective lists. These officers are then placed on half-pay until called into active service. The amount of this half-pay is usually 60 per cent. of the full pay of each grade in the service.

HALIBUT, *häl'-e-but*, a fish belonging to the family *Pleuronectidæ* and the genus *Hippoglossus*, according to the classification of Cuvier. The genus is characterized by a flat, oblong body, compressed vertically; the eyes and coloured surface are on the right side; both jaws and the pharynx are armed with strong teeth. The common species grows to a length of from three to six feet, varying in weight from 100 to 500 lb. It is found on the Atlantic coast of America from New York to Greenland, and also on the northern shores of Europe. It is an exceedingly voracious fish, feeding upon cod, haddocks, skates, mackerel, and other species of smaller size. It is not much esteemed in the English market, but in America it sells at a higher price than cod.

HALL, *hawl* (Sax. *heal*, Ger. *saal*, Lat. *aula*, Fr. *salle*), the principal apartment in the castles and mansions of the middle ages, which was used on all occasions of ceremony, and in which the meals were served. Some of the palaces of the early Saxon kings appear to have consisted of little else than the hall. The earliest existing specimens are of the 12th century; and though none of them retain their roofs or fittings, it is apparent that several of them were divided into three alleys, by rows of pillars and arches. In these halls the king, together with his courtiers and all his retainers, dwelt, sat at the same table, and round the same hearth. There was generally another smaller chamber attached, in which the king and his courtiers slept, while the retainers slept in the hall. The Normans built halls very similar to those of the Saxons; and with few modifications, similar buildings were erected until the 14th century. The population then being more numerous, and manners more refined, it became necessary to have more numerous apartments. The hall, however, held its place as the chief room of the house, in which the king or lord of the manor administered justice, gave audiences, or received and entertained his guests. From the 14th century downwards, numerous examples of large and stately halls still remain. The archbishop of Canterbury's palace, a ruin, at Mayfield, Sussex, the roof of which was supported on stone arches, reaching across the whole breadth of the room, is one of the finest of these relics. Another good example remains at Penshurst Place, Kent, which has an open timber roof. Halls of the Perpendicular style are very abundant: decidedly the noblest of these is Westminster Hall; but there are many others which are very fine; such as those at Eltham Place, Kent; Crosby Hall, London; Hampton Court; Athelhampton Hall, Dorsetshire; many of the colleges at Oxford and Cambridge; several of the inns of court in London, &c. These have all open timber roofs, considerably ornamented. The hall originally was essentially a part of feudal architecture. The principal entrance was at one end, where, in those which retain traces of the original fittings, a space is parted off by a screen, extending across the whole width, and supporting a gallery above. In the screen were doors leading into the body of the hall. At the upper end, a portion of the floor, called the dais, was raised one or two steps above the rest, on which was placed the principal table, at which the host and superior guests sat. The chief seat was in the middle, next the wall, commanding a view down the room. The fire, or open hearth, was often in the middle of the floor, and the smoke escaped through a louvre on the top of the roof; sometimes, however, fireplaces were formed in the side walls. In halls of the Perpendicular date there was a large bay window at one end (and sometimes at both ends) of the dais, where the "cupboard," or buffet, was placed. Many of these arrangements are still retained in the university halls.

HALLELUJAH, *häl'-le-lu'-yä* (Heb., praise ye the

Lord), is the name of a well-known doxology derived from the Old Testament, and frequently used in the ancient church. In some of the early churches it was sung generally throughout the year; in others it was sung only on Easter-day and the fifty days of Pentecost. It was occasionally, also, sung at funerals. In the fourth council of Toledo it is mentioned under the name of Laudes, and appointed to be sung after the gospels. The ancient church retained the Hebrew word, as did also the Church of England in its first liturgy; but now the English translation, "Praise ye the Lord," is used.

HALLEY'S COMET. (*See* COMET.)

HALLOWEEN, HALLOWEVEN, or ALLHALLOW EVEN, *hăl'-lo-een'*, is the eve, or vigil, of All-Saints' day, which is the 1st of November. It is still customary in some parts of England to crack nuts, duck for apples in a tub of water, or catch at them when stuck upon one end of a kind of hanging beam, at the other extremity of which is fixed a lighted candle, and that with the mouth only, the hands being tied behind the back. In Scotland these ceremonies are of a more superstitious character.

HALLUCINATION, *hăl-lu-sin-ai'-shun* (Lat. *hallucinatio*, from *hallucinor*, I err), denotes an error or mistake of the senses. It was a favourite maxim of Kant's, "that the senses do not deceive us at all,—it is only the judgment that deceives us." This is indeed true of illusions, where what is represented to consciousness are objects really existing, but different from what they really are; but it is not true as regards hallucinations strictly so called, where the senses convey to consciousness what do not really exist, representing as an object what is only a subjective process. As regards illusions, they are often owing to inexperienced judgment, or may also proceed from a defective state of the organ itself, and may be corrected by observation. Hallucinations, on the other hand, do not depend upon the judgment, but are somatico-physical abnormities, which are not influenced by experience. They sometimes affect only one, sometimes several, and even all of the senses. Hallucinations of the sight are perhaps the most frequent, and are commonly visions of sparks, flames, luminous spectres, terrific phantoms, &c. Hallucinations of hearing are also very common,—humming or ringing in the ear, the sound of voices, &c. Hallucinations of smell are much more rare; but hysterical persons often smell objects which are not present; such as sulphur, musk, violets, &c. Hallucinations of taste wholly resemble those of smell; and hallucinations of touch are also rare. In illusions we have chiefly to consider the external occasion and the mental condition of the individual; in hallucinations, the organic and physical condition. The illusion is often in the object, and is frequently produced by emotions, heated fancy, passion, &c. The hallucination has always a subjective ground; either the receptive organ suffers, or the leading nerve, or the reacting cerebral centre, chiefly from pressure of blood, cramp, &c. The course and termination of these states of mind, which are only symptomatic, issue, after longer or shorter duration, either in health, from undeceiving the patient, or, if this does not happen, in a fixed idea,—in insanity. The hallucinations of sight and hearing, on account of the psychical dignity of their organs, are especially of a fatal import.—*Ref.* Feuchtersleben's *Medical Psychology*.

HALO, *hai'-lo* (Gr. *halos*, a circle), the name given to a luminous circle that occasionally surrounds the sun, moon, planets, and fixed stars. It is sometimes white, and sometimes faintly tinged with colours like the rainbow. Most commonly but one ring only is seen encircling the heavenly body, but at times the halo assumes the form of several concentric rings of light. The halos seen about the moon, the planet Jupiter, and the fixed star Sirius, generally have an apparent diameter from three to five degrees; but when these phenomena appear round the sun, they often have a diameter of 90 degrees, and the diameters of halos round the moon have been frequently known to reach this extent. This appearance around the heavenly bodies is said to be very frequent in Russia and North America. Artificial halos may be produced by placing a lighted candle in the midst of steam in cold weather. It was also noticed by Muschenbroek, that the moon, when viewed through a window, the panes of which were covered with a coating of thin ice, was apparently surrounded by a halo, although there was none to be seen about it when this medium was removed. There are many theories with regard to the formation of halos, which appear to arise from the double refraction of the rays of light proceeding from any heavenly body, on their passage through thin clouds and aqueous vapour, or from the transmission of the light of these bodies through particles of hail or snow. The name *corona* is frequently applied to these phenomena.

HALOGENS, *hal'-lo-jens* (Gr. *hals*, a salt; *gennao*, I produce), in Chem., a natural group of non-metallic elements, which form direct saline compounds with the metals. They are chlorine, bromine, iodine, and fluorine. Odling defines halogens as those non-metallic elements which unite with hydrogen, volume for volume.

HALOID SALT, *hăl-oid'* (Gr. *hals*, sea-salt; *eidos*, likeness), in Chem., salt formed by the union of a halogen with a metal. Common salt, or chloride of sodium, may be taken as the type of the haloid salt.

HALORAGACEÆ, *hăl-er-ai-gai'-se-e*, in Bot., the Mare's-tail, or Water-chestnut fam., a small nat. ord. of *Dicotyledones*, sub-class *Calyciforæ*, consisting of herbs or shrubs, generally aquatic, with small flowers, which are frequently incomplete and unisexual. The order is nearly allied to the order *Onagraceæ*. The most interesting genus is *Trapa* (which *see*); the other genera are of little importance.

HALYARDS, *hăl'-yards* (Ang.-Sax.), in nautical language, the smaller ropes or tackle by means of which yards, sails, and signals are hoisted or lowered; as the *topsail halyards*, *signal halyards*, &c.

HAM, *hăm* (Du. *hammen*), a term applied in Commerce to the thigh of a hog or boar, salted and dried, so as to preserve it in a state having an agreeable flavour. In England, the best hams are made in Yorkshire, Hampshire, Wiltshire, and Cumberland; and in Scotland, Dumfries and Galloway are the counties most famous for hams. Those of Ireland are comparatively coarse, and without flavour. On the continent, the hams which are held in the highest esteem are those of Westphalia and Portugal. The ordinary method of curing hams in the most celebrated districts is to rub them with bay or other salt; then to leave them on a stone bench, in order that the brine may discharge itself. This rubbing process is repeated in a few days; about half an ounce of saltpetre (nitrate of potash) being added to each ham. After remaining on the bench, or in the salting-tub, for another week or so, they are generally hung up to dry in the sides of large open chimneys. In some cases they are exposed to the smoke of wood, peat, coal, and other varieties of fuel; while in other cases they are carefully protected from the smoke. When not sold sooner, they are kept in their drying situations till the commencement of the warm weather, when they are packed up in casks with straw, or the seeds of oatmeal, and consigned for sale. In the process of drying, hams lose about twenty per cent. of their weight. In Dumfriesshire, the pickle for hams is sometimes made with one half ale, which renders the hams shorter, and adds greatly to the richness of their flavour. The imports of bacon and hams into this country amount to nearly [illegible]0,000 cwt. a year. (*See* BACON.)

HAMAMELIDACEÆ, *hăm-ma-me-li-dai'-se-e* (Gr. *hamameles*), the Witch-hazel fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciforæ*, consisting of small trees and shrubs, having the following characters:—Leaves alternate, with deciduous stipules. Flowers perfect or unisexual; calyx superior, 4- or 5-lobed; petals 4 or 5, with an imbricated æstivation, or altogether wanting; stamens 8, half of them sterile, and placed opposite to the petals, and half fertile, and alternate with them; anthers 2-celled, introrse; ovary inferior, 2-celled; styles 2. Fruit capsular, 2-valved, with a loculicidal dehiscence; seeds pendulous and albuminous. These plants are natives of North America, China, Japan, the central parts of Asia, Madagascar, and South Africa. *Hamamelis virginica* produces oily edible seeds; its bark and leaves possess astringent properties. *Rhodo[illegible]a Championi*, a Chinese plant of this order, has very showy flowers. It has recently flowered for the first time in England.

HAMESUCKEN, *haim'-suk'-en* (Ang.-Sax.), in Scots Law, is a premeditated assault, aggravated by being committed in the dwelling-house of the person assaulted, to which he had fled for safety, or to which the assaulter had gone for the purpose of committing the offence. An assault committed on a sudden quarrel within the house is not of this nature. Neither is it hamesucken to strike a man in his place of business, or in an inn, or in the house of a friend, where he is temporarily residing. It is regarded as a capital offence, and hence is not bailable. The distinction is not known in the law of England.

HAMILTONIAN SYSTEM, *hăm-il-to'-ne-ăn*, is the given to a system of teaching languages, after Mr. James Hamilton (1769—1831), an English merchant, who afterwards took to teaching languages. His system is simply this,—to have some simple book in the language about to be learned, usually the gospel of St. John, with an interlinear translation, so literal as to show at once the number and case of the noun, as well as the mood, tense, and person of the verb. Each word has under it its exact English equivalent, and in its primary signification. There is thus no attempt to produce a translation, properly so called, to give the meaning of a passage as nearly as possible to the original, but only to give the correct rendering of each separate word by itself. The system is by no means without its value to the beginner, and is a vast improvement upon the old system of setting the pupil to learn no end of grammar rules before he was called upon to make any practical application of them. The Hamiltonian system has the advantage of bringing the pupil at once to a practical acquaintance with the rules and idioms of the language; by which means his attention is awakened and kept up, while, at the same time, he is acquiring a knowledge of words in the best possible manner, by having the foreign word, with its English equivalent, presented through the eye to the mind, together, or at the same instant. It is to be remembered, however, that this method is not to supersede the learning of rules, but ought to be carried on along with them; and also that it is to be regarded only as an initiatory process, to be cast aside after some progress has been made in the language.

HAMMER, *hăm'-mer* (Sax. *hamer*, Dan. *ham mer*), a term applied to the well-known tool used by mechanics, which consists of an iron head fixed crosswise upon a handle. The hammers, however, employed in the useful arts vary greatly in form, and the weights of individual examples may be estimated from several tons to the fraction of an ounce. The hammers used by blacksmiths are of several kinds. Amongst others, are the about-sledge, which is the largest of all, and is held by both hands at the furthest end of the handle, and being swung at arm's length above the head, is made to fall heavily upon the work. The up-hand sledge is not so large, but is used with both hands, and seldom raised above the head. The hand-hammer is the smallest, and may be used with one hand at the anvil. The class of hammers called riveting hammers have the handle fixed to them by passing it through a hole in the head, where it is made to fit or be wedged firmly; the face is formed of steel, as well as the riveting end, and welded to the iron. These hammers are used by carpenters, smiths, engineers, and numerous artisans, varying in size and form according to the purpose for which they are required. A variety of hammers having two claws, called claw-hammers, are much used by carpenters and other mechanics, as the claw, together with the handle, forms a powerful lever for drawing out nails, &c. The largest hammers are those used in the manufacture of iron. In this form they are not mere tools, but machines moved by steam or some other power. There are many varieties. Froming's forge-hammer, which is used for heavy castings, as well as for edge-tools, knives, files, &c., may be moved either by hand, water, or steam-power. A heavy hammer-head with a guide-rod, cones, and vertical spring, accomplish the work by means of a driving-shaft made to rotate by any source of power. In Hutton's power-hammer, the weight is raised by a strap or chain, attached to a drum or pulley on an axis; when the blow is struck, the momentum is made to assist in raising the hammer again. This hammer is much used in beating iron and steel between pairs of dies. The frictional-action hammer can be worked by any continuously revolving power-shaft, and can be made to hammer 150 blows per minute with a very heavy hammer-head. Cotton's air tilt-hammer, and Waterhouse's compressed-air forge-hammer for light work, in a smith's shop, are also useful varieties; and there are many more. The powerful machine called the steam-hammer was originally invented by Mr. Nasmyth, in 1842. (*See* NASMYTH HAMMER.) Steam-hammers, since that time, have received many minor improvements in their construction. In some cases the hammer-block is a sort of plunger, working in the cylinder, instead of a heavy mass suspended from the piston-rod; in some the hammer, piston-rod, and piston, are all cast in one piece, while others are so contrived as to increase the space through which the hammer falls to the anvil. A class of cheaper and simpler steam-hammers is also made for certain purposes, either in iron-forging, boiler-riveting, or ore-crushing. Some of the hammers now in use are of great weight. At the Bowling Iron-works, near Bradford, there is a steam-hammer of 6 tons weight. Messrs. Morrison, of Newcastle, constructed a steam-hammer for the Russian government, of which the weight of the piston, and piston alone, was 5 tons. At New York, there is a steam-hammer of 7½ tons. It seems probable, from the magnitude of the works undertaken in iron manufacture at the present day, that still larger and more powerful hammers will be constructed. (*See* STEAM-HAMMERS.)

HAMMOCK, *hăm'-mock* (Sp. *hamaca*), a term applied to the article which, suspended from the deck, supplies the place of a bed to the sailor. It consists of an oblong piece of strongly-woven hempen cloth, about seven feet long and three broad, to each end of which are attached several small cords, meeting in a ring, to which they are united; from each ring a lanyard, or small rope-line, suspends the "hammock" to the cleets or battens, fastened on the inner surface of the upper deck. The cleets are generally about nine feet apart; and inside the hammock are placed a pillow, a mattress, and a pair of blankets. In ships of war, during the day, the hammocks of the crew are placed in the nettings along the upper edge of the bulwarks of the main deck. The term *hammock* is likewise applied to a small mound, or protuberance of ice projecting above the frozen surface of a "floe," on account, no doubt, of the appearance of these mounds resembling the veritable article.

HAMPTON COURT CONFERENCE, *hămp'-ton*, was a conference summoned by James I., soon after his accession to the throne of England, to meet at Hampton Court, with a view to the settlement of religious differences, more particularly between the Episcopalians and the Puritans (January, 1604).

HANAPER OFFICE, *hăn'-ă-per*, the name of an office belonging to the common law jurisdiction of the court of Chancery. It is so called because all writs relating to the business of the subject, and their returns, were in early times kept in a hamper (Lat. *in hanaperio*), and the others, relating to matters in which the crown was directly or indirectly concerned, were kept in a small sack or bag; and hence the Petty-bag Office, another office of the common law court in Chancery.

HANCORNIA, *hăn-kor'-ne-ă*, in Bot., a gen. of the nat. ord. *Apocynaceæ*. The species *H. speciosa*, a native of Brazil, bears a very delicious fruit.

HAND, *hănd* (Ger. *hand*, Lat. *manus*), in Anat., is [illegible]

[illegible] embodied in the hand, is the most wonderful of the senses. The organs of the other senses are passive; the organ of touch alone is active." "The hand selects what it shall touch, and touches what it pleases. It puts away from it the things which it hates, and beckons towards it the things which it desires." "Moreover, the hand cares not only for its own wants, but when the other organs of the senses are rendered useless, takes their duties upon it." "The blind man reads with his hand, the dumb man speaks with it; it plucks the flower for the nostril, and supplies the tongue with objects of taste. Not less amply does it give expression to the wit, the genius, the will, the power of man. Put a sword into it and it will fight, a

plough and it will till, a harp and it will and it will paint, a pen and it will What, moreover, is a ship, a railway, a lighthouse, a palace,—what, indeed, is a whole city, a whole continent of cities, all the cities of the globe, nay, the very globe itself, so far as man has changed it, but the work of that giant hand with which the human race, acting as one mighty man, has executed its will."—(*Five Gateways of Knowledge.*) The hand is that which distinguishes man in the class of mammals, he being the only animal possessed of two hands (*bimana*). That which constitutes the hand, properly so called, is the power of opposing the thumb to the other fingers, so as to seize upon the most minute objects. The hand is composed of a number of small bones, twenty-seven in all, so arranged as to combine the greatest possible degree both of strength and flexibility. These are arranged in three divisions,—those of the carpus, metacarpus, and phalanges. The carpus, or wrist, comprises eight bones, arranged in two rows, four in each; and are the scaphoid, naviculare, or boat-shaped bone; the semi-lunar, or halfmoon; the cuneiform, or wedge-shaped; the pisiform, or pea-like; the trapezium; trapezoid; os magnum, or great bone; and the unciform, or hook-shaped. The metacarpal bones are five in number, and constitute the bones of the palm and back of the hand. The phalangeal bones are fourteen in number, three for each of the four fingers, and two for the thumb. They are named in their numerical order from above downwards, *i.e.*, from the palm of the hand. The inferior extremity of the radius and ulna articulate with the scaphoid, semi lunar, and cuneiform bones of the first row of the carpus. The articulations between the first and second rows of the carpal bones are very remarkable. These articulations are connected by numerous ligaments running in various directions, by means of which the bones are kept in their proper positions. The second row of carpal bones articulate with the metacarpal, and form the carpo-metacarpal articulations. They are connected by dorsal and palmar ligaments, stretching from the carpal to the metacarpal bones. The metacarpo-phalangeal and inter-phalangeal articulations are similarly formed, and are connected by lateral ligaments on each side, and a strong ligament in front. Besides these there are the various muscles of the hand, which give to it its several motions of flexion, extension, abduction, adduction, and circumduction. The hand is also richly supplied with blood-vessels and nerves.—To such as desire a particular account of the wonderful structure of this portion of the human frame, we would recommend Bell's excellent treatise *On the Hand*.

HAND HABEND, in Law, is applied to a thief caught in the very fact, having the thing stolen in his hand.

HAND-PLANT. (*See* CHEIROSTEMON.)

HANDS, IMPOSITION OR LAYING ON OF, is a ceremony performed in the conferring of holy orders, in which the hands are laid on the head of a person as a sign of a mission, or of a power given him to exercise the functions of the ministry belonging to the order. The missionaries appointed by the apostles in the early church were ordained by the laying on of hands.

HANDSPIKE, *hănd'-spīke*, in Nautical Lang., a wooden lever used on board ship to work round the windlass or capstan. One end of the handspike is inserted in the holes at the capstan head, or in the bend of the windlass, and the men take hold of the other, and, by dint of pushing or pulling, as the case may be, hoist the yards or weigh the anchor, which they would be unable to do by mere mechanical labour, unassisted by leverage.

HANDWRITING, *hănd'-ri-ting*, in Law, is, in general, proved by a witness who has seen the person write. The mark of a person who cannot write is proved by a person who has seen him make his mark, and is acquainted with it. In some circumstances, as where the party is resident abroad, the evidence of one who has frequently received letters from him would be admitted, though he had never seen him write. It is sufficient that a witness swear according to his belief; but this belief must be founded upon rational grounds, and he may be asked to say what these grounds are. Evidence of handwriting by comparison is inadmissible, except where the writing acknowledged to be genuine is already in evidence in the cause, or the disputed writing is an ancient document. This rule does not, however, apply to the court or the jury. Inspectors of franks, clerks of the post-office, and such-like persons skilled in handwriting, have in some cases been allowed to give evidence; but great doubts are entertained as to the admissibility of such evidence.

HANGED, DRAWN, AND QUARTERED. (*See* HANGING.)

HANGING, *hăng'-ing* (Sax. *hangan*, to hang), is a mode of capital punishment which has been used in this country from time immemorial. In atrocious cases, it was formerly usual for the court, in passing sentence, to direct the criminal, after execution, to be hung upon a gibbet in chains near the place where the fact was committed; also that the execution take place on the day next but one after receiving his sentence, and that his body be delivered to the surgeons to be dissected. These severities were abolished by several statutes passed in the reign of William IV. Formerly, the punishment of high treason was very severe. The offender was to be drawn to the place of execution; to be hanged by the neck, and then cut down alive; his entrails taken out and burned before him; then his head cut off, and his body divided into four parts; the head and quarters to be at the king's disposal. But by 54 Geo. III. c. 146, the sentence now awarded is to be drawn on a hurdle to the place of execution, and there to be hanged until dead; and then afterwards the head to be severed from the body, and the body to be divided into four quarters, to be at the king's disposal. The king may, however, discharge all the punishment except the beheading. Hanging is applied to that kind of death in which the body is wholly or partially suspended by the neck, the constricting force being the weight of the body itself, while in strangulation it is due to some other cause. In both cases death commonly results from asphyxia. If, however, the cord be loose, or applied to the upper part of the neck, a small quantity of air may still reach the lungs, and in such cases death will arise from apoplexy, the cerebral circulation being interrupted by the pressure. In many cases death is produced by a mixed condition of asphyxia and apoplexy. In the execution of criminals, it has often been observed that death does not always ensue within the same period of time; which is to be accounted for from the greater or less degree of constriction produced by the ligature. In some rare cases, death has taken place with great rapidity, owing to a displacement of the dentiform process of the second cervical vertebra, by which the spinal marrow became suddenly compressed. This cause of death, however, is extremely rare, and is only likely to occur in very corpulent subjects, when a long fall is given to the rope, and when much violence is at the same time employed by the executioner. Sometimes violent convulsions are observed of the limbs and trunk; but there is no reason to believe that the individual suffers pain then any more than in an epileptic fit. It has often been found impossible to restore animation after the body has been suspended only a very few minutes. Sometimes here, as in drowning, a person may in the first instance recover, and subsequently die, in spite of the best medical treatment, from the depressing effects produced on the muscular and nervous systems. In attempting to restore animation in such cases, artificial respiration, cold affusion when the skin is warm, with the vapour of ammonia, and other stimuli, are recommended to be employed. The application of electricity, or electro-magnetism, in the course of the spine is also sometimes attended with benefit. If there should be much cerebral congestion on recovery, venesection may be cautiously resorted to. From experiments, as well as from the evidence of persons who have been resuscitated, we learn that asphyxia comes on in the most insidious manner in death from ; and that the slightest constriction of the will speedily produce insensibility. Such persons have been conscious of a ringing in the ears, flash of light before the eyes, then darkness and stupor. In medical jurisprudence it often becomes an important question to determine whether the individual was suspended before or after death, and which must often be determined by the circumstances of each case, as there is no distinctive sign by which the hanging of a living body can be determined, or which

may not be simulated in the dead subject. It is also often important to determine whether the individual hanged himself or was hanged by others; and here, too, an opinion can only be arrived at from a consideration of the circumstances. In such cases, however, the presumption is in favour of suicide, as hanging is a difficult mode of perpetrating murder, unless the strength of the parties be gr[illegible]y disproportionate, [illegible] the assailants numerous. H[illegible]ng is also sometimes the result of accident.—*Ref.* Taylor's *Medical Jurisprudence.*

HANGING GARDENS, in Antiq., a series of magnificent gardens laid out on elevated terraces at Babylon, and supposed to have been constructed by Queen Semiramis. According to Diodorus and Strabo, the form of these gardens was square, each side being about 400 feet in length; so that the area of the base was nearly four acres. In Dr. Falconer's "Historical View of the Gardens of Antiquity," quoted in Loudon's "Encyclopædia of Gardening," it is stated that "they were made to rise with terraces constructed in a curious manner, above one another, in the form of steps, and were supported by stone pillars to the height of more than 300 feet, gradually diminishing upwards till the area of the superior surface, which was flat, was reduced considerably below that of the base. This building was constructed by vast stone beams placed on pillars of stone (arches not being then invented), which were again covered with reeds, cemented with bitumen, over which was placed a double row of bricks united with cement. These bricks were covered with plates of lead, which effectually prevented the moisture from penetrating downwards. Above all was laid a coat of earth, of depth sufficient for plants to grow in it; and the trees planted there were of various kinds, and were ranged in rows on the side of the ascent, as well as on the top, so that at a distance it appeared as an immense pyramid covered with wood. The situation of this extraordinary effort of human skill aided by wealth was nearly adjoining to, or upon, the river Euphrates, from which water was supplied by machinery for the fountains and reservoirs employed for cooling the air and watering the garden." The different terraces and groves also contained fountains, parterres, seats, and banqueting-rooms, and combined the minute beauties of flowers and foliage (only to be rightly estimated in those desert plains) with recesses of shade and extensive prospects. The existence of these hanging gardens has been doubted by some authorities; but it is said that their locality can be traced, and their ruins discovered, amongst the numerous mounds of sand which mark the position of ancient Babylon.

HANSARD'S DEBATES, *hăn'-sards*, the title of a work, started by Mr. T. C. Hansard in the year 1812, as a continuation of Cobbett's Parliamentary History, and in course of publication at the present day. Cobbett's Parliamentary History traces the early institution, history, and proceedings of the English Parliament, from the year 1066 to the year 1803 (12th August). Hansard's Debates takes up the thread of the history where Cobbett stopped, and gives clear and concise reports of all debates, bills passed, and motions made, both in the House of Lords and the House of Commons, from November, 1803, up to the present time. At the commencement of the publication of Mr. Hansard's Debates, it was planned that two volumes should be given annually; but latterly, the sittings in Parliament being greatly prolonged, and the subject matter of the debates correspondingly spread out, it has been found necessary to give sometimes four, and even five volumes, in order to chronicle the proceedings of each session. Without any literary or political bias, Hansard's Debates are merely reports of all that takes place in the houses of Parliament, and are consequently the best books of reference on the subject.

HANSEATIC LEAGUE, *hăn-se-ăt'-ik leeg* (Ger. *hanse*), was a celebrated commercial confederacy formed among certain commercial cities of North Germany, in the 13th century, and took its name from the old German word *hansa*, signifying an association or confederacy for mutual aid. As the commercial cities of the North began to increase in wealth and importance, they came to be harassed by the attacks of pirates and robbers, and various tolls were imposed which interfered seriously with trade. These circumstances at length gave rise, in 1239, to an agreement between Hamburg, Ditmarsh, and Hadeln; and in 1241 a confederacy was formed between Hamburg and Lübeck, in which they mutually agreed to protect each other against all violence. This confederacy was joined by Brunswick in 1247. In a short time the number of the members had so much increased that in 1260 a diet was held at Lübeck, the chief city of the league. Regular meetings of the confederacy now took place there every three years, about Whitsuntide, and the general archives of the league were kept there. The confederacy was at its highest degree of power and splendour during the 14th and 15th centuries, and comprised at one time no fewer than eighty-five cities. These were distributed into four classes or circles. Lübeck was at the head of the first circle, and had under it Hamburg, Bremen, Rostock, Wismar, &c. Cologne was at the head of the second circle, with twenty-nine towns under it. Brunswick was at the head of the third circle, which comprised thirteen towns. Dantzic was at the head of the fourth circle, having under it eight towns in its vicinity, besides several others that were more remote. The supreme authority of the league was vested in the deputies of the different towns assembled in congress. In it they discussed all their measures, it decided upon the sum that each city should contribute to the common fund, and upon the questions that arose between the confederacy and other powers, as well as those that frequently arose between the different members of the confederacy. Any one might be chosen a deputy; and, besides merchants, the congress comprised clergymen, lawyers, artists, &c. When the deliberations were concluded, the decrees were formally communicated to the magistrates of the cities at the head of each circle, by whom they were subsequently communicated to those below them; and the most vigorous measures were adopted for carrying them into effect. One of the burgomasters of Lübeck presided at the meetings of congress, and during the recess the magistrates of that city had the sole, or, at least, the principal, direction of the affairs of the league. Sometimes congresses were held at other places besides Lübeck, as Hamburg, Cologne, &c., and extraordinary congresses were also occasionally held. As the power of the confederated cities increased, they became more ambitious; they endeavoured to acquire the monopoly of the trade of the North, and to obstruct and hinder the navigation of foreign vessels in the Baltic. They succeeded in obtaining, partly in return for loans of money and partly by force, various privileges and immunities from the northern sovereigns, which secured to them almost the whole foreign commerce of Scandinavia, Denmark, Prussia, Poland, Russia, &c. They now declared their object to be to protect themselves and their commerce from pillage, to guard and extend the foreign commerce of the allied cities, and as far as practicable to monopolise it; to manage the administration of justice within the limits of the confederacy; to prevent injustice by public assemblies, diets, and courts of arbitration; and to maintain the rights and immunities received from princes, and, if possible, to increase and extend them. The league exercised a judicial power, and inflicted the greater and lesser ban; any place which incurred these punishments, being said to be *verhansed*. At length there was no mart in Europe that was not gradually drawn within the circle of its influence; and by the greatness of its wealth, and the might of its arms, it became the mistress of crowns, lands, and seas. It conquered Eric and Hakon, kings of Norway; and Waldemar III., of Denmark. It deposed a king of Sweden, and gave his crown to Albert, duke of Mecklenburg. In 1428 it equipped a fleet of 248 ships, with 12,000 soldiers, against Eric of Denmark. In the country under its immediate influence, it constructed canals, and introduced a uniform system of weights and measures. In order to facilitate and extend their commercial transactions, the league established various factories in foreign countries: at London in 1250, at Bruges in [illegible] at Novgorod in 1272, and at Bergen in 1278. At [illegible] on their factory was of considerable size and importance. They enjoyed various privileges and immunities; they were permitted to govern themselves [illegible] regulations; had the custody of

one of the gates of the city (Bishopsgate) committed to their care; and the duties on various kinds of imported commodities were considerably reduced in their favour. Their factory in London was situated in Thames Street, and was known as the "Steelyard." (*See* STEELYARD.) In the Netherlands, Norway, and Russia, they enjoyed the like important privileges. The foreign factories were subjected to an almost monastic strictness of discipline, which even required the celibacy of the factors, clerks, &c. After the middle of the 15th century, the power of the league began to decline, not owing to any misconduct on the part of its leaders, but to the progress of that improvement which it had done so much to promote. The civilization, which had been at first chiefly confined to these cities, gradually spread from them, as from so many centres, over the contiguous country. The people began to be sensible of the advantages to be derived from commerce and navigation, and their princes also saw it to be for their advantage to encourage such enterprises; while at the same time the roads or seas were no longer insecure. In addition to these circumstances, the interests of the different cities which composed the league were becoming daily more and more opposed to each other; and the discovery of America led to a total revolution in the state of trade. The last diet of the confederation was held at Lübeck in 1630, when the union was dissolved. Hamburg, Lübeck, and Bremen subsequently formed an association among themselves, and remained free republics till 1810, when they were incorporated into the French empire. In 1813 they again became free, and, in conjunction with Frankfort-on-the-Maine, were recognised as the "Free Hanseatic Cities," and form a part of the Germanic Confederation.—*Ref.* McCulloch's *Essay on the Rise, Progress, and Decline of the Hanseatic League*; Sartorius's *Urkundliche Geschichte des Ursprungs der deütschen Hansa* (3 vols. 1802-8), continued by Dr. J. M. Lappenberg (2 vols. Hamburg, 1830); Burmeister's *Beiträge zur Geschichte Europas im 16 Jahrh.* (1813); Lappenberg's *Urkundliche Geschichte des Hansischen Stahlhofes zu London* (Hamburg, 1851).

HAPPINESS, *hăp'-pe-ness* (Ang.-Sax.), is the great object of all human action, and, in its most general sense, includes all other objects. To be happy includes or supersedes all other gratifications. If we are happy, we do not miss that which we have not; if we are not happy, we want something more; whatever we have, the desire of happiness is the supreme desire. All other desires, of pleasure, wealth, power, fame, are included in this, and are subordinate to it. Since happiness is necessarily the supreme object of our desires, and duty the supreme rule of our actions, there can be no harmony in our being, except our happiness coincide with our duty. That which we contemplate as the ultimate and universal object of desire, must be identical with that which we contemplate as the ultimate and supreme guide of our intentions.—*Ref.* Whewell's *Morality*; Harris's *Dialogue on Happiness.*

HAPSBURG, or HABSBURG, *hăps'-burg, habs'-burg* (contracted from *Habichtsburg*, Hawk's Castle), is the name of the present imperial family of Austria, and is derived from the castle of Habsburg or Habichtsburg, on the Wülpelsberg, on the right bank of the Aar, in the present Swiss canton of Aargau. The castle was built in the 11th century, by Werner, bishop of Strasburg, grandson of Guntram the Rich, count of Alsace and Breisgau, and who is said to have been a descendant of Ethico I., duke of Alemannia and Alsace. The proprietors of Hapsburg became, at a later period, counts of Hapsburg; and, gradually extending their dominions, subsequently assumed the title of Landgrave. In 1273, Rudolf, of this house, became emperor of Germany, and is the founder of the reigning family of Austria. The subsequent history of this house forms part of the history of Germany and Austria.—*Ref.* Prince Lichnowski's *Geschichte des Hauses Habsburg*, 8 vols., Vienna, 1836-37.

HAQUEBUT, *hăk'-but.*—When the hand-gun and arquebus were first introduced, the butt or stock was perfectly straight, and in the form of a stick or broom-handle, which prevented the soldier who was using it from taking a proper aim by directing his eye along the barrel. To obviate this inconvenience and imperfection in the weapon, the Germans fitted the barrel to a hooked butt,—whence the name, by which means the firearm could be discharged from the chest as before, while an additional facility was given for taking aim at the object towards which the weapon was directed. It was introduced into England about 1485. The haquebut may be considered as the first step in the long series of improvements in small arms which seem to have culminated in the rifles produced by Whitworth, Jacob, Lancaster, Henry, and other makers and inventors.

HARBOUR, *har'-bour* (Ang.-Sax.), the ordinary name given to any port or haven communicating with the sea, or with a navigable river or lake sufficiently deep to float ships of moderate size. The chief characteristics of a good harbour are, that it should be free from all rocks or shallows; the opening should be extensive enough to admit large ships at all times of the tide; it should have good anchorage-ground, be easy of access, and be well protected from the violence of the wind and sea. The interior of the harbour should be sufficiently capacious for the reception of the shipping of various nations, and deep enough to allow ships to lie close alongside the quays or piers, in order that the expense of loading and unloading by means of lighters may be avoided. There should also be proper lights and lighthouses, and the quays should be furnished with proper rings, posts, moorings, &c., in order to remove or secure vessels. The principal harbours in Great Britain are those of Portsmouth, Milford Haven, and the Cove of Cork.

HARBOURS, or HAVENS.—According to the law of England, the king has the prerogative of appointing ports and havens, or such places only for persons and merchandise to pass into and out of the realm, as he in his wisdom deems proper. It has always been holden that the king is lord of the whole shore, and practically is the guardian of the ports and havens, which are the inlets and gates of the realm. Though the king had the power of granting franchise of ports and havens, yet he had not the power of resumption, or of narrowing or confining their limits when once established; but various acts were passed (the earlier being superseded by 6 Geo. IV. c. 105), enabling the crown, by commission, to ascertain the limits of all ports, and to assign proper wharfs and quays in each, for the exclusive landing and lading of merchandise. The crown, however, has the power of opening and shutting ports for the purpose of prohibiting the importation or exportation of goods. In 1847, an act was passed consolidating into one the provisions usually contained in acts authorizing the making and improving of harbours, docks and piers. The act 10 Vict. c. 27, provides for the making and improving of harbours, docks, and piers; authorizing the undertakers to levy rates, and laying down sundry rules for their guidance. The act has been in some measure altered by the "General Pier and Harbour Act," 1861 (24 & 25 Vict. c. 45), for facilitating the formation, management, and maintenance of piers and harbours in Great Britain and Ireland; and the "Harbours and Passing Tolls Act," 1861 (24 & 25 Vict. c. 47), to facilitate the construction and improvement of harbours, by authorizing loans to harbour authorities to abolish passing tolls, and other purposes. Many of the harbours are also regulated by private acts.

HARD LABOUR, in Law, is a punishment frequently added to imprisonment, and is said to have been introduced in the reign of Queen Anne. The kind of labour varies according to the nature of the prison and other circumstances, and is usually for ten hours a day.

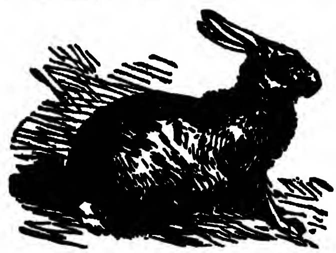
HARDNESS, *hard'-ness* (Ang.-Sax.), a term applied to that condition of the force of cohesion in solids, which enables their constituent molecules to retain their relative position, and resist any physical force which tends to alter the figure of the body. Hardness is entirely different from density; for, although gold and platinum are denser than glass, yet glass is harder than gold or platinum. Iron and zinc are lighter, but harder, than gold or platinum. Sir Isaac Newton [illegible] the primary particles of all bodies to be hard, and not capable of being broken or

divided by any power in nature; but, with all our extended knowledge, it is impossible to determine, with any certainty, the conditions of the elementary particles which render bodies hard, brittle, malleable, ductile, &c. Some metals are rendered hard with great readiness. This is of inestimable value in the manufacture of steel especially, which can be varied in hardness by heating suddenly, cooling, and then tempering. Hardness is often accompanied by brittleness; but this can generally be overcome by heating and slow cooling; this process, however, often takes away from the hardness. In the production of alloys, another useful property is frequently developed. Copper and tin, neither of which is remarkable for hardness or elasticity, possess both these qualities when combined; in which form they constitute bell-metal.

HARDNESS OF MINERALS, in Min.—Mineralogists are accustomed to divide minerals into ten classes, according to their hardness, diamond being at one end of the scale and talc at the other. Their hardness is tested by their capability of being scratched, or of scratching the minerals, in the following table, invented by Mohr:—Talc 1, rock-salt 2, calc spar 3, fluor spar 4, apatite 5, adularia felspar 6, rock crystal 7, topaz 8, corundum 9, diamond 10.

HARE, *hair* (Sax. *hara*, Lat. *lepus*) one of the *Le-*

grinders, each formed of two plates in both jaw. Hares have large lustrous eyes placed laterally, long ears, a hairy tongue, an incomplete clavicle, weak forefeet, and a very short hairy tail. In disposition, they are gentle, timid animals, and, being possessed of remarkably quick hearing, are frightened at the least noise. Their mode of progression mostly is by a series of leaps, and their flight, when alarmed, is rapid in the extreme. They live on vegetable food, as the young shoots and bark of trees, growing corn, and other similar substances. They are very prolific; and were



HARE.

it not for the multitudes which are annually shot or otherwise slaughtered for the London market, they would soon overrun the country. Hares form a great object for pursuit on the part of sportsmen; and hunting them with the greyhound is termed "coursing." (*See* GREYHOUND.) They exist in Europe, America, Asia Minor, Syria, and in fact in nearly all countries; and of course there are many varieties of their conformation. The young are called *leverets*, and the nest of a hare, or the place in which it reposes during the day, is termed its "*form*." The Romans, it is said, prized the hare very much as an article of food; but it was forbidden to the Jews, the Mahomedans, and, it is also stated, to the ancient Britons. As the common hare is the type of the recognized family, it alone has been selected for the subject of the present article; but further information regarding the different varieties will be found under the separate articles headed LEPORIDÆ and LAGOMYS.

HAREBELL. (*See* CAMPANULA.)

HARE-LIP (Lat. *labium leporinum*), in Surg., is applied to a congenital malformation of the lip, from its fancied resemblance to the lip of a hare. It is a cleft or division of one or both lips, but usually the upper. Sometimes there is a considerable space between the parts, and occasionally the cleft is double, there being a little lobe, or small portion of the lip, between the two fissures. Sometimes, also, the fissures extend through the bones of the mouth. The operation for hare-lip consists in paring off the edge of the separated parts on each side, and bringing the two new surfaces together, so as to close up the fissure, retaining them in their places by means of ligatures.

HAREM, *ha-reem'* (Arab., the sacred or inviolable), is the name given among Mohammedans to those apartments which are appropriated exclusively to the female members of a family.

HARICOTS. (*See* PHASEOLUS.)

HARLEIAN COLLECTION. (*See* BRITISH MUSEUM.)

HARLEQUIN, *har'-le-kwin* (Ital. *arlecchino*, Fr. *arlequin*), is the name of a personage who figures largely on our stage in the pantomimes, and who has been borrowed from the Italian. The origin of the personage and the etymology of the name are matters of dispute. Probably, however, the character has been handed down from the ancient Greek or Roman dramas. Riccobini conjectures that the dress of the harlequin is no other than the *centunculus* of the old Roman *mimi*, who had their heads shaved, and were called *planipedes*. Harlequins and buffoons are also called *zanni* by the best Tuscan writers, probably from the Latin *sannio*, of which Cicero (*De Oratore*, ii. 61) gives a description applying so strongly to the harlequin as to place his derivation from the *planipedes* almost beyond a doubt. The character of the ancient harlequin was a mixture of extravagant buffoonery with great corporeal agility, while his expressions were characterized by impudence, drollery, satire, and often indelicacy. His character, however, changed about the middle of the 16th century. He became a simple, ignorant servant, who assumes all colours, and is easily induced, through fear or interest, to commit all sorts of tricks or knaveries. He excels in extempore sallies, and tries very hard to be witty, even at the expense of being malicious. In other countries where introduced, his character has been more or less modified. (*See* PANTOMIME.)

HARMONICA, *har-mon'-e-ka*, a musical instrument now seldom or ever used, which derived its origin from the musical glasses. Its sounds are produced from glasses blown as nearly hemispherical as possible, each having an open neck or socket in the middle, into which a perforated cork is fitted. Near the brim, the glass is about one-tenth of an inch thick, but increases towards the neck, which is, in the largest, about one inch deep and half an inch wide within, the dimensions lessening in proportion as the glasses diminish in size, all excepting the smallest, which ought not to be less than half an inch in length. The largest glass is nine inches in diameter and the smallest three. Between these there are twenty-three different sizes. They are distinguished by painting the apparent parts of the glasses on the inside, every semitone white, and the other notes of the octave with the seven prismatic colours; so that glasses of the same colour, white ones excepted, are always octaves to each other. The glasses are placed on a round iron spindle (fixed horizontally in the middle of a box, and made to turn on brass grudgeons at each end), one within the other, each leaving about an inch of its brim above that of the other. The spindle is turned by means of a foot-wheel, and the tones produced by rubbing the exposed parts of the glasses with the ends of the fingers damped and rubbed with chalk, to bring out the tone more readily. The glasses also should be occasionally wetted with a sponge and clean water. The production of the sound by means of the naked finger is said to have such an effect upon the nervous system as, in some cases, to have caused fainting-fits. Many attempts were made to play it by keys, but none have succeeded, no dead substance having been yet found capable of giving the same expression to the sound as the human fingers.

HARMONICS, *har-mon'-iks*, in Mus., a term applied to those concomitant, accessory sounds which accompany the predominant and apparently simple tone of any chord or string, as well as to the mathematical mensuration of musical sounds,—whatever appertains to harmony; as the harmonic divisions of the monochord, the harmonic proportions, &c. The doctrine of the ancients was divided into seven parts; viz., sounds, intervals, systems, genera, tones, mutations, and melopœia.

HARMONITES, *har'-mon-ites*, the name of a sect o enthusiasts founded by one Rapp, a native of Wür temberg, born 1770. Finding no peace in his nati place, he and his followers emigrated to America 1803, and established themselves near Pittsburg, Pennsylvania, where they founded what they termed the Pure Apostolic Church, living in a kind of socia brotherhood, having all things in common, and th like times for rest and enjoyment. They subsequentl removed to Ohio, where they founded the colony Economy. Rapp died in 1847, and was succeeded head of the Harmonites by one Becker. They numbe about 4,000.

HARMONIUM, *har-mo'-ne-um* (Gr.), a musical instru ment of modern invention, bearing some affinity to the organ, but, unlike that instrument, made upon principle technically termed the *free vibrating reed*, which was long supposed to have been a European discovery, but is now ascertained to have been known in China long before it was heard of in Europe. Th free reed consists of a brass plate containing an oblon slit, having a thin elastic tongue fixed to one end, i such a manner, and so exactly fitting into the slit, as t completely close it, but so that it will, upon the pres sure of the wind on the free end, pass either inward or outwards, without touching the end or sides. It has several advantages over the beating-reed of the organ In the first place, its tone is of a more agreeabl quality; secondly, it requires no pipe, which is an indispensable addition to the organ; thirdly, it is much less liable to get out of order; and, fourthly, it gives an entirely new property,—viz., the power o *expression*. Debain, of Paris, was the first to construc a keyed instrument upon the free-reed principle of really useful character. Several attempts had been made, but all had more or less failed, until Debair invented the harmonium. This instrument is about 3 feet high by 3 feet 9 inches broad, its depth varyin according to the number of stops. The key-board i immediately below the lid, and its compass extend five octaves, from C to C. This now, however, in th best instruments, is virtually converted into seven by the more perfect arrangement of the stops. The valves are beneath the key-board and on the top of the wind box, within which are the different rows of reeds, th pitch of which is regulated by their size, which varies from half an inch to 3½ inches in length, whilst the quality of the sound is modified by the breadth of the vibrating portion and the shape of the hole covered by the valve. The wind is supplied by means of bellows with two feeders, which the player moves alternately with his feet. For the deep bass notes the springs are heavily loaded at the loose end, to make them vibrate slowly; while for the higher notes they are made thinner at that end. Some harmoniums have only one row of reeds, others four; some also have two rows of keys. Lately, a "knee movement" has been intro duced, by which a small degree of crescendo may be produced on either bass or treble. The manufacture of this instrument has greatly increased within the

Exhibition for 1862, Messrs. Chappell & Co. exhibited a large harmonium, the great feature of which is, that it can be used either as an organ or harmonium, having a pair of harmonium treadles, which open out from the front of the instrument, coming over the organ pedals; these being shut up, and the wind sup plied by another person, the instrument may be used as an organ. Messrs. Boosey & Ching also exhibited some of these instruments, the most important of which was their "large pedal harmonium."

HARMONY, *har'-mo-ne* (Gr. *harmonia*), the agreement of two or more united sounds. It may be either *natural* or *artificial*; the former consisting of the har monic triad, or common chord, and the latter of a mixture of concords and discords, bearing relation to the harmonic triad of the fundamental note. With the Greeks, the word harmony was in all probability limited in its signification to that agreeable succession of sounds which is now called air, or melody; while in modern music it is not employed to designate a mere succession of unaccompanied sounds, but a union of melodies, a succession of combined sounds, composed of consonant intervals, and moving according to the stated laws of modulation. Harmony is the combina tion of sounds and the succession of chords, and may be said to combine the life and soul of music. The ancients knew very little of harmony, and it has not yet been introduced into the music of the Chinese and other Eastern nations. It is a comparatively modern invention. The laws regulating the succession of chords were at first rather arbitrary. (*See* CHORD.) Har mony may be divided into simple and compound. Simple harmony is that in which there is no concord to the fundamental above an octave. Compound har mony is that which to the simple harmony of an octave, adds that of another octave. From the union of har mony and melody music is formed. Although melody may exist without harmony, harmony cannot exist without the melodious arrangement of each of its several parts. Melody is distinct from harmony, in that it is a succession of musical sounds, while har mony is produced by their combination. Every chord, whether consonant or dissonant, forms harmony. All harmony in music is derived from what is called the aliquot tones. If a string be made to vibrate, the sound produced at first appears to be single; but, upon a closer and more careful observation, it will be found that the fundamental sound, more especially if it be a deep one, is accompanied by others in the most perfect harmony. These accompanying sounds are exactly those on which the chords in music are formed, and on which the foundation of the whole system of harmony is built.—Some of the best works on harmony are those by Albrechtsberger, Dr. Marx, and Professor Dehn.

HARMONY OF THE GOSPELS is the name given to a certain class of books, which have for their object the reconciliation of the narratives given in the four evan gelists, or the accounts contained in them digested into one continued narrative. There are many instances of things omitted by some, and given by others, of the evangelists; many repetitions, and not a few seeming contradictions. In order to show the concurrence or agreement of the several gospels, and to reconcile such discrepancies, is the object of these harmonies. By this means, each story or discourse is exhibited with all its concurrent circumstances; frequent repetitions are prevented, and a number of seeming oppositions reconciled. The great difficulty in such cases arises from the fact that each of the evangelists had a distinct end in view in writing his gospel, in the elucidation of which, strict chronology was not an essential element. The gospels are thus not, strictly speaking, systematic biographies; and hence the difficulty, if not impossi bility, of establishing a perfect harmony among them. The first work of this kind was the "Diatessaron" of Tatian, who flourished in the latter half of the 2nd cen tury. In the next century appeared a similar work by Ammonius; but from that time for many centuries no other work of the same kind was published. In modern times, however, the number of such works does not fall short of two hundred; a fact proving at once the difficulty of the subject and the interest taken in such matters. The best harmonies are those of Calvin, Chemnitz, Calixtus, Lightfoot, Cradock, Le Clerc, Bengel, Doddridge, Macknight, Newcome, White, Griesbach, Thompson, De Wette and Lücke, Chap man, Lant, Carpenter, Reichel, Wieseler, Robinson, Greswell, Da Costa, Stroud, and Mimpres. The term harmony is also used with reference to the agreement which the Gospel bears to natural religion and the works of God in general.

HARMONY OF THE SPHERES.—Many of the ancient philosophers held that the regular movements of the various heavenly bodies through space produced a kind of harmony, which they called the "harmony of the spheres." Our great poet has said,—

> "There's not the smallest orb which thou behold'st,
> But in his motion like an angel sings,
> Still quiring to the young-eyed Cherubim."
> *Merchant of Venice.*

HARMONY, PRE-ESTABLISHED, in Phil., is the name given to a doctrine which professes to explain the con nection that subsists between spiritual and material substances, and which was introduced by Leibnitz. He holds that God, before creating the soul and body

of man, had a perfect knowledge of all possible souls and all possible bodies. Among this infinite variety of souls and bodies it would be impossible but that there should be souls whose series of perceptions and determinations would correspond to the series of movements which *some* of these possible bodies would execute. Now supposing that of such a soul and such a body God should make man, it is evident that between the two substances which constitute this man there would subsist the most perfect harmony. These would have no communication, no mutual influence, the one upon the other; each would act by virtue of its own nature, like two clocks accurately regulated, which point to the same hour and minute, although the spring which gives motion to the one is not the spring which gives motion to the other. This harmony being established before the creation of man, is hence called the pre-established or pre-determined harmony. This doctrine is frequently alluded to in philosophical works but it is needless to attempt any refutation of it, as it is at best merely a hypothesis, and was probably regarded even by the author himself more as a specimen of ingenuity than as a serious doctrine.—*Ref.* Hamilton's *Lectures on Metaphysics*, vol. i. pp. 303-4.

HARP, *harp* (Sax. *hearpa*), a stringed instrument of music, highly esteemed by the ancients, which may be traced, under various forms, to the remotest ages of antiquity. It was held in high veneration amongst the Celts, and although it has disappeared from the Highlands of Scotland, may still be found amongst the Welsh and Irish. In Ireland, its former prevalence has led to its adoption as the national symbol. There is little doubt that it was brought to great perfection in Egypt, as its figure has been found drawn on buildings of the greatest antiquity, while at Thebes, a fresco painting of a harp was discovered by Bruce, which he thinks was executed by order of Sesostris, who reigned between fourteen and fifteen hundred years before the Christian era. In Holy Writ we find the harp continually mentioned, while its invention is ascribed to Jubal, seventh only in descent from Adam. There are three kinds of harps now known,—the Italian harp, the Double, or David's harp, and the Pedal harp. The first of these is very imperfect, and seldom or ever used. The double harp is a better instrument, of a triangular form, having gut strings and a sounding-board; but it was not until the invention of pedals, in 1720, by Hochbrucker, that this instrument became really useful. For its present improved and nearly perfect state we are indebted to M. Sebastian Erard, of Paris, who patented a harp with seven pedals in

[illegible]

two actions. This instrument is tuned in the key of C flat, but may, by fixing the pedals in the first groove, be at once transposed to that of C natural, while, by fixing them in the second, it is transposed into that of C sharp. The compass of this instrument is from E double below the bass to E in altissimo.

HARP, ÆOLIAN. (*See* ÆOLIAN HARP.)

HARPOON, *har-poon'* (Fr. *harpon*), an iron spear or javelin, shaped like a barbed arrow at one end, with a ring at the other, through which a rope is run, used for the purpose of spearing whales in the Greenland and other whale-fisheries. The gun-harpoon, or harpoon-gun, is a weapon used for the same purpose, but which is discharged from a swivel or gun, instead of being thrown by hand. This weapon is formed entirely of metal, and has a chain attached to it, to which the usual line is joined on, as in the former case. The manner in which the harpoon is used, and whales captured, will be given under the article WHALE.

HARPSICHORD, *harp'-si-kord*, a musical instrument exactly resembling a grand pianoforte in shape, formerly much used, but now entirely superseded by the piano. The date of its invention is unknown, although it is supposed to have been about the 16th century; it was not, however, introduced into England until the 17th. It consists of a mahogany or walnut-wood case, within which is the belly or sounding-board, over which the strings are stretched, supported by bridges. The sound is produced by small pieces of crowquill or hard leather, which project from the jacks (small pieces of wood that stand upright between the strings), and which, when the instrument is in use, are pushed upwards by the keys till they touch the strings, causing a brilliant but rather harsh sound. The great fault in the harpsichord is its deficiency of any means of modification in respect to piano and forte notes.

HARQUEBUS. (*See* ARQUEBUS.)

HARRIER, *hăr'-e-er* (Ang.-Nor.), is a species of hound employed in hunting the hare. This animal is supposed to be a cross between the foxhound and the beagle, and is remarkable for its sagacity in tracing, and the boldness with which it pursues its game. There are three prominent varieties in the *harrier*, according to Blaine, in his "Rural Sports;" namely, the old southern hound, the modern harrier, and the beagle. Many subordinate divisions, however, accrue, and a cross breed is used for otter-hunting. The modern harrier in appearance is little more than a dwarf foxhound. In choosing a pack of harriers, their size and form should be adapted to the country which they are to hunt over; some sportsmen appear to have a *penchant* for those that are undersized, as the open lands about Dorchester used to be hunted with a pack of seventeen couple, none of which were more than seventeen inches in height. Mr. Beckford states that the hounds most likely to show the best sport are those produced by a cross between the large slow hunting harrier and the little fox-beagle; the former having a good scent, and the latter being fleet of foot; and they thus produce a hound which possesses both advantages.

HARROW, *hăr'-ro* (Ang.-Sax.), an agricultural implement formed of bars of wood or iron, fastened together transversely, either at right angles to each other, or diagonally, with iron teeth projecting downwards from the points of intersection perpendicularly, or with a slight inclination. A harrow with the bars set diagonally is the best, as their inclination to each other may be regulated in such a manner that each tooth marks out a separate furrow; in consequence of which the implement performs its work more effectually than it would if the bars were disposed, as in the old harrow, at right angles to each other. There is also an expanding harrow, in which the framework of bars is fastened together by loose pins, so that the teeth can be set closer together or further apart, as the state of the soil may require. The harrow is used in bringing land that has just been ploughed into a proper condition for the reception of the seed, by breaking the clods of earth into smaller fragments, tearing out the roots of the weeds or stubble, and pulverising and mixing the soil. To effect this, and to render the surface tolerably smooth and even, the land is rolled and harrowed two or three times with different harrows, a strong heavy harrow being used to break the furrows made by the plough, and lighter harrows, with the teeth set more closely together, in the final stages of the process. There are many patent harrows manufactured by Ransome & May, of Ipswich, Barrett, Exall, & Andrews, of Reading, and other agricultural implement makers; among which may be mentioned that invented by Finlayson, which consists of an iron framework running on wheels, having iron teeth attached to cross bars of the same metal, which clear the [illegible] of weeds, and drag them from the ground, without clogging the machine. It is fitted with a lever, by which the depth to which the teeth enter the ground may be regulated. A bush harrow consists of a hurdle, or frame of wood, with some rough boughs and bushes interlaced between its rails. It is often drawn over newly-sown lands, for the purpose of covering the seed with a thin layer of earth; but it is chiefly used for pulverising manure and earth that has been spread over pasture-lands.

HART. (*See* DEER.)

HARTFORD CONVENTION, *hart'-ford*, in the Hist. of the United States, was an assemblage of delegates from the New England states, which met at Hartford, Connecticut, December 15, 1814. The war between Great Britain and the United States, which began in 1812, was from the first distasteful to the great majority of the people of New England, who had suffered immense losses from it, by the destruction of their commerce and fisheries. The defence of the New England coast was neglected by the federal government, and the

British were beginning to attack it with vigour. A committee of the Massachusetts legislature recommended a convention of the New England states, and a circular letter was addressed to the others, calli[illegible] upon them to meet in convention "to devise means [illegible] security and defence which may be consistent with the preservation of their resources from total ruin, and adapted to their local situation and mutual relation and habits, and not repugnant to their obligations as members of the Union." The convention sat for twenty days with closed doors, and on their adjournment embodied the result of their deliberations in a report addressed to the legislatures which they represented,—moderate in tone, [illegible] in sentiment, expressing strong affection for the U[illegible] and the greatest aversion to violent or unconstitutional measures. It, however, recommended to these legislatures the adoption of such measures as might be necessary effectually to [illegible] f acts passed [illegible] bjecting the militia and other persons to forcible drafts, conscriptions, or impressments, not authorized by the constitution of the United States. It also proposed certain amendments on the federal constitution. The holding of this convention and its supposed treasonable designs caused a great outcry among the democratic party, and much apprehension at Washington. The imputation of treasonable designs to it continued until a very recent period, and resulted in excluding from political power in the state almost every man implicated in its doings. It is now, however, generally believed that it was guiltless of any designs which could be regarded as treasonable.

HARTSHORN, SPIRITS OF. (*See* AMMONIA.)

HARVARD COLLEGE, *har'-vard*, is the oldest college of the United States, and is situated at Cambridge, three miles from Boston, Massachusetts. It was founded in 1636, only six years after the establishment of this region by the English. Afterwards, in 1639, the name, which was first Newtown, and then Cambridge, was changed to Harvard, in consequence of a liberal endowment of about £700 left to it by the Rev. John Harvard, in 1638. It has received various other public and private grants. The external government of the college, as provided for by its charter, and by subsequent enactments, is vested in two separate boards,—viz., the president and fellows, and the overseers; the internal, by the faculty, composed of such of the college officers as are brought into immediate connection with the students by supervising their studies and conduct. There are 33 professors, and 18 tutors, proctors, &c., and about 700 pupils, of whom more than half are undergraduates, the others attending the professional courses, of which there are four,—law, science, medicine, and theology. The number of actual graduates of the college exceeds 7,000, of whom 2,600 are living. The academic year is divided into two terms, wi[illegible] seven weeks in July and August, and six weeks in January and February. Of late years, the standard of education has been greatly raised and extended; and the institution at present enjoys a good name for its care and thoroughness in teaching. The college library contains upwards of 124,000 volumes.

HARVEST, *har'-vest* (Sax. *hærfest*), the period at which any crop is reaped, although it is more generally applied to the crops of corn and hay. It is one of the most important times to the husbandman, as, although h[e] may have had a good season for the growth of his p[r]oduce, yet a bad harvest will deprive him of the g[r]eater portion of the return he expected. In order t[o] obviate some of the casualties which thus attend t[h]e farmer in moist climates, the times of sowing different grains, &c., are regulated so as to insure their coming to maturity in rotation. The first harvest in Britain is that of the forage grasses, or other plants that are made into hay; the next is the harvest of cereal grasses, or of corn crops (this is the true *harvest*); and the third, the potato harvest, or harvest of root crops; such as potatoes, carrots, turnips, mangel-wurzel: there is also a harvest of occasional crops; as hemp, flax, rape-seed, &c. Harvest time is generally a very joyous time, and great mirth and festivity celebrate the end of the husbandman's labours. The *harvest-home* is kept when the last of the crop has been carted into the farmer's storehouse, and the name is applied to the feast which the employer gives to all his "hands" at the termination of their labours. At this season, also, large numbers of Irishmen and Scotchmen come over into [illegible] for the purpose of assisting in reaping the crops; and [illegible] this means, in consequence of the facility of labour, [illegible] standard of farm wages is much lowered during harvest time.

HARVEST MOON, the moon which during the autumnal months, when near its opposition, rises nearly at the [illegible] hour for several evenings. During the time that our satellite is full, and for a few days before and after, in all about a week, there is less difference between the time of her rising on any two successive nights than when she is full in any other month in the year. By this means an immediate supply of light is obtained after sunset, during the continuance of these *harvest moons*, which is extremely beneficial to the husbandman for gathering in the fruits of the season. In order to gain an insight into this phenomenon, it must be borne in mind that the moon is always opposite to the sun when she is full; that she is full in the signs Pisces and Aries, these being the signs opposite to Virgo and Libra, which the sun passes through in September and October, our harvest months. Thus, although, whenever the moon enters the two former signs (and she does so twelve times in a year), the same circumstance takes place with regard to the time of her rising, yet it is not observed on these other occasions, just because she is not *full* at the time. The reason of there being little difference in the time at which she rises on several consecutive nights, is, that at these periods her orbit is nearly parallel with the horizon. The harvest moons are as regular in southern latitudes as with us in northern latitude, only they happen at different periods of the year.

HASCHISCH. (*See* CANNABIS.)

HASP AND STAPLE, *hăsp, stai'-pl* (fr. Sax.), in Scots Law, was the old form of entry of an heir on property situated in a royal burgh. It consisted in the heir, accompanied by a bailie and the town clerk, appearing on the premises, when the bailie directed the heir to take hold of the hasp and staple of the door as a symbol of possession; he then entered the house and bolted himself in; and on his coming out, the transaction was noted and registered. This form is now no longer necessary.

HASTA, *hăst'-ă* (Lat.), a spear used by the ancient Romans and Greeks, and called by the latter *paltón*, or *doru calcharos*,—a pole fitted with bronze. The *hasta* was often fitted up in the market-places, or auction marts, where slaves were to be sold. The term *hasta* was also applied to the long sceptre which the mythic gods generally appear holding in their hands; and it signifies indifferently both a [illegible] javelin, and sundry other weapons of [illegible] SPEAR.)

HASTINGS, BATTLE OF, *haist'-ings*, a memorable event in the annals of English history, was fought between William, duke of Normandy, and Harold II., king of England, on the 14th of October, 1066. The Norman invader landed at Pevensey, on the coast of Sussex, on the 29th of September, and afterwards marched to Hastings, where he encamped, having with him an army of 60,000 men. Harold II., who was at that time in the north with his army, as soon as he received news of this event, hastened southwards, and came in sight of the Normans on the 13th of October. He unwisely resolved to risk a battle the next day, and both armies were drawn up in regular lines at a place called Senl[ac] now Battle, near Hastings. The conflict was long a[nd] bloody, lasting from sunrise to sunset; but at leng[th] the English were defeated, Harold, his two bro[thers] and many of the nobility, being among the [slain]. After this event William had little difficulty in establishing himself upon the English throne; and a memorable epoch was introduced in the annals of the country by what is known as the "Conquest." In 1067 William founded an abbey near the place where the victory was gained, which is now known as Battle Abbey.

HAT, *hăt* (Sax. *haet*), a covering for the head, made of different materials, and worn by men and women for the purposes either of defending the head from rain or heat, or for ornament. The period of the intro-

duction of the hat into England is not exactly known but it is mentioned by some of the early chronicler and historians. In the reign of Queen Elizabeth Stubbs thus writes of the hats of the period :—"Some times," says he, "they use them sharpe on the crowne, peaking up like the speare or shafte of a steeple, standing a quarter of a yarde above the crowne of the head. Some others are flat and broade on the crowne like the battlements of a house. Another sorte have round crownes, sometimes with one kind of band sometimes with another: now black, now white; now russet, now red; now green, now yellow; now this, now that; never content with one colour or fashion two days to an end." Samuel Pepys, in his Diary dated June 27th, 1660, states, "This day Mr. Holder sent me a beaver, which cost me £4. 5s." About the beginning of the 18th century, the crowns of hats were mostly round, and had very broad brims, much resembling the Quaker hats which are still in use. In 1704, the regular three-cocked hat came into use, and held the sovereignty of head-coverings until about 1760, when a flat-topped, full-brimmed hat usurped its place. About thirty-five years later, the cylindrical hat, now in general use, came in vogue, and at the beginning of the 19th century was generally adopted, to the extinction of the cocked hat. The only ceremonial or professional hat now in use is that adopted by bishops and other dignitaries of the English church; and this is a round hat made of beaver, with a very broad brim looped up at the sides and back, so as to resemble slightly a shovel in appearance; whence it is termed a "shovel hat." Hats for men are mostly constructed of the fur of the beaver, but are also made of felt, straw, and grass, although those of the latter materials come under the denomination of "tourist" hats. Those for women are made of braid, cloth, straw, and grass, and many other fancy materials. The mode in which hats are constructed, and the various processes they go through, will be found given under the article HAT MANUFACTURE (*see* next art.).

HAT MANUFACTURE.—The principal materials of which hats are manufactured are—fur, wool, silk, and straw. Hats made of silk plush, drawn over a coarse stiffened textile fabric as a foundation, are those that are most generally used in the present day, with hats of felted wool and fur, without any nap, that are either soft and yielding, or brought into the usual hat shape by being blocked and stiffened with a composition prepared for the purpose. Straw hats are made of lengths of straw-plait sewn together in the desired shape. Hats with a nap composed of the fur of the beaver are now but little worn; as the silk hat, although of the same objectionable shape, and exerting even greater pressure on the forehead, is cheaper and far neater in appearance. The body of the beaver hat is formed of lamb's-wool and rabbit's fur, that are first bowed or mixed together, and then felted by damping the materials and working them together with the hands. By these means the fur and wool are blended together in a thick close mass resembling a conical cap. This is reduced in size, and thickened by working it with the hands on the edge of a boiler containing sulphuric acid, beer-grounds, and water,—with which mixture the felt is repeatedly moistened, the manipulation being continued until the materials have united together as closely as they possibly can, and the felt will admit of no further contraction in size. After this the body is stiffened with a composition made of resinous substances, and then submitted to the action of heat, that the felt may be thoroughly penetrated and charged with the varnish that has been applied to it. To form the glossy nap of the hat, a little beaver fur, which has been shorn from the skin by a machine, is partially felted together and spread over the surface of the body, the two substances being united by the felting process, which causes the ends of the beaver fur to enter and adhere to the four lation of fur and lamb's-wool. Some beaver fur is also felted round the edge of the interior of the cone, in order to form the under part of the brim. The hat is then fashioned into shape by the hand, on a wooden block; after which the nap is combed, and the fibres are cut to a uniform length. After the hat has been boiled for some time in a dye of ...od, sulphate of iron, gall-nuts, and water, it is ..., and the crown stiffened by the insertion of a circular piece of pasteboard. The last process to which it is subjected is that of brushing and ironing the fur until all the fibres lie in the same direction; after which it is lined, and the edge of the brim bound. Felt hats, or "wideawakes," whether soft or stiff, are made chiefly of wool, and a similar process is gone through in their manufacture, in which machinery and moulds are sometimes employed. In the manufacture of silk hats, the plush which forms the external covering is sewn together, and drawn over the stiffened body, which is made of coarse canvas, chip, horse-hair, thin sheets of cork, and a variety of substances. Before the plush is put on, the body is covered with varnish, which melts on the application of a heated iron, and causes the silk covering to adhere closely to the foundation. The edges of the plush that covers the sides of the hat are not sewn together, but fastened to the body with the varnish, the nap being carefully brought over the line in which the edges are joined, in order to hide it. In some hats contrivances are introduced, both in the crown and brim, for the purpose of securing ventilation, as the want of free circulation of the air in the interior of the hat, when placed on the head, is said to injure the roots of the hair and cause baldness. In the *gibus* hat, the sides are made of merino, or some similar material, and the crown and brim, which are stiff, as in an ordinary hat, are connected by a set of springs, so that the hat can be flattened or expanded at pleasure. Nothing can be said in favour of the shape of the hat that custom compels the majority of Englishmen to wear in public; it is far from becoming in appearance, and most uncomfortable when worn for any length of time, on account of the pressure that it exerts on the forehead. The only way in which some slight alleviation of the discomfort occasioned by wearing such a covering for the head can be obtained, is by holding the interior of the hat towards the fire until the stiffening varnish is melted to a certain extent, and the body softened. It should then be pressed firmly on the head, and allowed to remain there until the varnish has again grown cold, by which its shape is brought more in accordance with the formation of the skull of the wearer, and the hat is rendered a little more bearable than it was before the operation that has been mentioned.

HAT-MONEY, or PRIMAGE, is a small duty paid to the captain and mariners of a vessel, over and above the freight, for their care and trouble. The amount is regulated by the custom of each particular place.

HATCHING, *hătsh'-ing* (Ger. *hecken*, to hatch), the incubation or lying down of an animal upon her own or another's eggs, and so communicating to them heat. By this means she maintains them at her own temperature, a condition essential to their development. The development of the fœtus takes place in many animals after the exclusion of the egg, and while it is kept in external contact with the parent's body, as in the case of the crab and lobster tribes, beneath the caudal plates; or agglutinated to the surface of the abdomen, as in certain species of pipe-fish; or concealed in cutaneous marsupial cavities, as in other species of the *Syngnatus* and the *Hippocampus*; in the case of those cold-blooded animals, however, the protection of the ova seems to be the object, and not communication of warmth. True hatching, or incubation, only takes place among the oviparous warm-blooded animals; namely, birds. A due degree of warmth is absolutely necessary to hatching. The mean temperature required is 100° Fahr.; it may vary from 95° to 105°, and towards the close of the process may be suspended for one or two hours, or even for a longer period, according to the amount of extraneous heat which the exposed eggs receive. The power which birds possess of communicating the proper amount of heat to their eggs depends upon a peculiar plexus of vessels distributed over the skin of the abdomen, which in most birds is connected with a derivation of blood from the internal organs of generation. The uncontrollable propensity which birds have to incubate arises from the vascular, hot, and sensitive condition of the abdomen. The eggs of the bird present several peculiarities in relation to the circumstances under which the fœtus is to be developed. By their oval form they present a large surface to the source of heat, while the hard calcareous nature and arched form of the shell preserve them from injury

from the incumbent pressure of the parent bird. The shell is also porous, which assists the heat and air to pass into the egg, and the germ is surrounded by a sufficient store of nutritive matter. This matter is of two kinds,—the internal part, called the yolk, and the external, called the white or albumen, which entirely disappears during the process of hatching. The germ is situated at the superficies of the yolk, beneath the membrane, in the circular opaque white spot usually called "the tread." The period of incubation is generally in proportion to the size of the bird; but the degree of development at which the young bird arrives differs in various species. Many birds show wonderful instinct in the manner in which they prepare their nests, not only for the process of hatching their young, but also for their protection and warmth after being hatched. The practice of artificial hatching was well known in ancient Egypt and China. At the present day artificial hatching by means of ovens, stoves, or steam, is greatly used in the former country. It has been calculated that nearly 93,000,000 chickens are annually hatched in the ovens of Egypt. The French philosophers have bestowed considerable attention upon artificial hatching, and one of the best results of their labours was the *Eccaleobion*, or egg-hatching machine, exhibited in London some years ago.

HATCHMENT. (*See* ACHIEVEMENT.)

HATCHWAY, or HATCH, *hätsh'-way* (Ang.-Sax.).—Hatches are oblong or square openings in the decks of a ship, forming the communications between one deck and another. There are usually three; viz., the main hatchway, situated just before the mainmast, which is the largest; the fore hatchway, situated a little abaft the foremast; and the after hatchway, placed between the main and mizen masts. The fore and after hatches, being used principally for communication, are fitted with ladders. In merchant vessels there are frequently other hatchways. When not in use, the hatchways are covered with wooden gratings, and during stormy weather with tarpauling, to prevent the water getting below.

HATTI SHERIF, or HATTI HUMAYUN, *hat'-te sher'-if, hoo-ma'-yoon* (Turkish, exalted, or august writing), is the name given by the Turks to every rescript of the sultan. It is in the Turkish language, and written in the Arabian court-hand,—Divâni. Above the text, as a sign of its authenticity, stands the ornamental name-flourish of the sultan, commonly black, sometimes red, and in some cases golden. This flourish is called *Tugra*, or *Rischamsherif*, *i. e.* exalted sign, and the official who superscribes it is called *Rischandschi*, *i. e.* signer. The most celebrated hatti sherif of recent times is that of Gulhana (Nov. 3, 1839), guaranteeing life and property to all subjects of the empire, without distinction of creeds. This was confirmed by a new hatti sherif (Feb. 18, 1856), proclaiming equality of all creeds and nationalities, making non-Mohammedans admissible to public office, and permitting foreigners to hold landed property. A hatti sherif is irrevocable.

HAUTBOY, or OBOE, *o'-boy* (Fr.), a musical wind instrument of the reed kind, which at a very early date took its place as one of the essential instruments of the orchestra. It consists of a tube, made of box, ebony, or cocoa-wood, about twenty-one inches long, narrow at the top but gradually widening towards the lower end or bell, and divided into three pieces or joints. In the upper and middle ends are holes, by stopping or opening which with the fingers the natural scale is formed, the intermediate semitones being produced by means of the keys, of which some hautboys have but two, while others have fifteen, and sometimes more: they are seldom made now with less than fifteen keys. Its range of available notes extends from B to G in alt. The tone of the hautboy is rich and sweet, and is particularly adapted to *piano* and *dolce* passages. This term is also given by organ-builders to a reed stop.

HAVEN. (*See* HARBOUR.)

HAVERSACK, *hăv'-er-săk* (Fr. *havresac*), is a strong bag, made of some coarse material, used for carrying provisions on the march.

HAVILDAR, *hăv-il-dar'*, is the highest rank to which a non-commissioned officer can ascend in the native regiments of India and Ceylon; and consequently the rank is somewhat analogous to that of a sergeant-major in the English army.

HAWFINCH. (*See* GROSBEAK.)

HAWK, *hawk* (Sax. *hafoc*), a term applied in Orn.

the length of their tail. The fourth quill-feather is the longest, the first, second, and third gradually exceeding each other in length. The beak is short, and hooked from the base; and the upper mandible, though not furnished with distinct teeth, like the true falcons, has the festoon, or prominence, that generally supplies its place, more strong and angular than is usual among these tribes. Hawks are generally natives of cold climates; they skim the ground with a low and rapid flight, sometimes seizing their prey upon the wing, and sometimes swooping upon it from above. The common sparrow-hawk may be taken as a type of the family. It is to be found in nearly every part of Europe, and its range extends from Russia to the Cape of Good Hope: it is also to be found in Japan. Great Britain it has the reputation of being the most destructive of all the native rapacious birds. It is generally to be found in wooded neighbourhoods, and preys upon partridges, pigeons, &c., and is the terror of the poultry-yard. The female sparrow-hawk

SPARROW-HAWK.

is nearly fifteen inches in length, and the male about three inches shorter. Their nest is built in high rocks, lofty ruins, or hollow trees; but their eggs are frequently laid in the deserted nests of crows or other birds. In former times this bird was used in falconry, and was considered the best hawk for landrails. In ancient times it was held in high estimation by the Egyptians, amongst whom it was an emblem of Osiris; the Greeks consecrated it to Apollo. The goshawk is a larger species than the sparrow-hawk, and is also found in many countries. (*See* GOSHAWK.) There are many other species of hawks, such as the *Accipiter dukhuniensis*, found in the Deccan; others, such as the *Herpetheteres cachinnans*, found in America. In South America there are several varieties, and a collared sparrow-hawk which possesses all the destructiveness and courage of its European ally, is found in Tasmania. In Africa, a sparrow-hawk (*Nisus musicus*) has been observed, which is commonly called the chanting falcon. It is the only raptorious bird gifted with the power of song; but its notes can hardly be called harmonious or musical; its voice is simply a little clearer than usual; but it seems to have a high notion of its own powers; for it will sit for half a day, perched on a tall tree, uttering its unceasing cry.

HAWKERS, PEDLARS, and PETTY CHAPMEN, *hawk'-ers* (Ang.-Sax.), are persons travelling from town to town, selling goods and merchandise. Act 50 Geo. III. c. 41, repealed the previous acts on this subject, and placed the duties of hawkers and pedlars under the management of the commissioners of hackney coaches. It imposed a duty of £4 per annum on every such trading person going from town to town, or to other men's houses, and travelling either on foot or with horse, &c.; and the sum of £4 yearly additional for every horse, ass, mule, or other beast, bearing or drawing burden, he or she shall so travel with. Before obtaining license, they are required to produce a certificate, signed by some clergyman, or by two respectable inhabitants, attesting that they are of good character and reputation. Every such person is required to have legibly written, painted, or printed in

large Roman capitals, on every pack, box, trunk, cart waggon, &c., and likewise upon every handbill or advertisement which he may give out, the words "licensed hawker." A licensed hawker is not allowed to open a room or shop, and expose for sale any goods or merchandise by retail, in any town or parish where he is not a householder, or which is not his usual place of abode, in order to sell, by himself, or by any auctioneer, &c., by outcry, as in a sale by auction, or other mode whereby the best or highest bidder is, or shall be deemed to be, the purchaser. A licensed hawker, however, selling in such premises by retail, does not offend against this clause, which only applies to selling by outcry, &c., or by some mode of sale at auction. A licensed auctioneer, going from town to town, and sending goods by public waggons and selling the same on commission by retail or by auction, at the different towns, is a trading person within the meaning of the act, and must take out a hawker's license. The act does not extend to hinder any person from selling any goods in any public market, mart, or fair, nor to prohibit any person or persons from selling any printed papers licensed by authority, or any fish, fruit, or victuals; nor the real workers or makers of any goods, wares, or manufactures of Great Britain, or their children, apprentices, or known agents or servants, usually residing with such real workers or makers only, from carrying abroad and exposing to sale, and selling by retail or otherwise, any of said goods, wares, or manufactures of their own making, in any mart, market, or fair, in any city, borough, or market-town; nor any tinkers, coopers, glaziers, &c., usually trading in mending kettles, tubs, &c., from going about and carrying with them proper materials for mending the same Act 52 Geo. III c. 108, declares that no wholesale trader in lace, woollen, linen, silk, or any of the goods, wares, or manufactures of Great Britain, and selling the same by wholesale, either by himself or his servants or agents, shall be deemed a hawker within the meaning of the above act. Act 1 & 2 Will IV. c. 22, places the collection of duties paid by hawkers, &c, under the care and management of the commissioners of stamps for the time being. Act 22 & 23 Vict. c. 36, empowers justices, in convicting for offences under the Hawkers Act, to mitigate the penalties there prescribed to not less than one-fourth part over and above the necessary costs of proceedings; and no hawker's license required to be taken out by any worker or maker to sell his goods anywhere, either by himself, child, agent, or apprentice. By 23 & 24 Vict. c. 111, hawkers' licenses, granted either in England or Scotland, are good for any part of Great Britain; and the commissioners of inland revenue may remit penalties incurred by unlicensed hawkers, in whole or in part, although portions of these may be payable to other parties than the Crown. By 24 & 25 Vict. c. 21, hawkers having the proper excise license are authorized to sell sugar and tea; persons exposing goods for sale at private houses to be deemed hawkers, with the exceptions already specified. *Licenses may also be granted* by any inland revenue officer, on certificate by a justice of the peace or a police inspector. It is also provided, that a hawker, pedlar, or petty chapman, if he shall travel on foot without any horse or other beast, and carry his goods to and sell them at other men's houses, and not at any house, shop, room, booth, stall, or other place, in any town to which he may travel, may obtain a license, for a period not exceeding six months, at £1; exceeding six months, £2. If he shall travel with an ass, mule, or horse not exceeding thirteen hands in height (four inches to the hand), where the license shall be for a period not exceeding six months, £2; exceeding six months, £4.

HAWKING, *hawk'-ing* (Sax. *hafoc*, a hawk), the art of training and flying hawks, in order to take other birds. The practice of teaching one bird to fly at and catch another is frequently called falconry, and is of high antiquity. Amongst the Asiatics the sport seems to have been practised from the earliest period; and in the time of Ctesias, foxes and hares were hunted in India by means of rapacious birds. It is not certain, but very probable, that the ancient Greeks used hawks and other birds of prey in hunting and fowling. From the East the art gradually spread over Europe, and, although scarcely known to the Romans in the days of Vespasian, was practised with enthusiasm by the ancient Britons, who maintained a considerable number of birds for the sport. In after-times, from the Heptarchy to the days of Charles II., hawking was a favourite amusement of the English. A person of rank scarcely stirred out of doors without his hawk on his hand; and in old paintings and seals this is the criterion of nobility. In the Bayeux tapestry, Harold, when setting out on a most important embassy to Normandy, is represented with a bird on his hand and a dog under his arm. In olden times this diversion was the favourite amusement of all ranks of men; and while it was the privilege of the poor, was the pride of the rich. The expenses of the sport were sometimes very great. Sir Thomas Monson, in the reign of James I., is said to have given £1,000 for a cast of hawks. The laws with regard to the protection of the birds were also very rigorous Edward III. made it felony to steal a hawk; and to take its eggs was, even in a person's own ground, punishable with imprisonment for a year and a day, besides a fine at the king's pleasure. With these slight restrictions, hawking remained a favourite amusement in merry England till the reign of Queen Elizabeth, when the imprisonment was reduced to three months; but the offender had to find security for his good behaviour for seven years, or lie in prison till he did so. The sport of hawking was so universally popular in Britain at that period, that a certain quality of hawk was apportioned to every one, according to his station in life. Thus the eagle or vulture was given to the emperor, the ger-falcon to the king, the falcon gentle, or the tercel gentle, to the prince, the rock-falcon to the duke, the peregrine falcon to the earl, the bastard falcon to the baron, the sacre to the knight, the barrier and the lammaret to the esquire, the merlin to the lady, the hobby to the young man, the gos-hawk to the yeoman, the tercel to the poor man, the sparrow-hawk to the priest, the musket to the holy-water clerk, and the kestrel to the knave or servant. The birds most generally used in hawking were the peregrine falcon and the ger-falcon. When under a year old, hawks were called *red hawks*, on account of their plumage being dusky red in colour. When over a year old, the hawk was called a *haggard*. Several of the birds employed for the sport in this country are still to be found in Scotland and Wales. The peregrine falcon inhabits the rocks of Caernarvonshire; and the same species, with the ger-falcon, the gentil, and the gos-hawk, are found in Scotland, and the lanner in Ireland. In the old time, the Norwegian hawks were held in high esteem in England, and were not considered unbefitting bribes for the king. It is recorded that Jeoffrey Fitzpierre gave King John two good Norway hawks, in order to procure for his friend the right of exporting a hundred-weight of cheese. In some cases hawks were made the tenures by which several of the nobility held their estates from the crown. Sir John Stanley and his heirs held a grant of the Isle of Man from Henry IV., by paying two falcons to the reigning sovereign on the day of coronation. Although hawking, as an exercise, has now gone nearly out of use, several of the terms employed still hold their place in the lan-

DRESSED HAWK.

guage. Every part of a hawk has its distinct name. The legs, from the thigh to the foot, are called *arms*; the toes, the *petty singles*; the claws, the *pounces*; the wings, the *sails*. The crop is called the *gorge*; the upper part of the bill, the *beak*, the lower part, the *clap*; the yellow part between the beak and eyes, the *cere*, and the small holes in it, the *nares*. The furniture, the leathers, with bells fastened on the legs, are called *bewits*; the leathern thong by which the hawk is held is called the *leash*; and the little straps fastening them to the legs, the *jesses*. A head covering, in order to keep the bird in the dark, is called a *hood*, and to draw the strings, so that the hood may be in readiness to be pulled off, is called *unstriking the hood*. The *lure* is a figure or resemblance of a fowl made of leather and feathers; and the resting-place when the hawk is off the falconer's hand, the *perch*. Many of the particular actions of the hawk are also described by distinct terms. When the bird flutters on the hand or perch, it is said to *bate*, when standing too near, hawks fight with each other, it is called *crabbing*; when the young ones quiver in obedience to the elder, it is called *cowering*. The seizure of its prey by a hawk is called *binding*; when it pulls off the feathers, it is said to *plume*; when it forsakes the proper game, and flies at magpies, crows, &c., it is called *check*. The fowl or game flown at is called the *quarry*, and the dead body of a fowl killed by the hawk is called the *pelt*. The making of a hawk tame and gentle is called *reclaiming*, the bringing one to endure company, *manning*; and a hawk well enough trained to set an example to a young one is called a *make-hawk*. George, earl of Orford, tried to revive hawking in the latter part of the 18th century; and, in Yorkshire, Colonel Thompson had a hawking establishment at a later period. As a general diversion, however, in this country, the sport has entirely gone out, although now and then occasional attempts have been made to revive it. In Sir Walter Scott's novels, there are some very graphic and interesting descriptions of this national sport. A list of the hawks in use at the time of Charles I. will be found in Walton's *Complete Angler* (see also *The Book of St Albans*, by Juliana Berners, abbess of Sopwell; *La Fauconnerie*, by Charles d'Esperon; and Latham's *Falconry*).

Hawse, *hawze* (Ang.-Sax.), a term applied to the situation of the cables before a ship's stem, when she is moored with two anchors, one on the starboard and the other on the port-bow. When these cables verge from each other, the hawse is said to be *clear*, when crossed by the ship's swinging half-round, the hawse is said to be *crossed*, another cross makes what is termed an *elbow*, and then a *round-turn*;—in both these latter cases, the ship is said to have *foul hawse*. The process by which the cables are disengaged from these entanglements is called *clearing hawse*. *Freshening hawse*, means veering out more cable, in order to render the friction of the *fouled* cables more evenly distributed. *Athwart hawse* means crossing the bows of a ship at anchor.

Hawse-holes, the holes in the bows of a ship through which the cables pass that are attached to the anchors.

Hawser, *haw'-zer* (Ang.-Sax.), a large cable, of intermediate size between the cable and *tow-line* of the ship to which it belongs: it is used for various purposes; as warping out of dock, or towing, &c.

Hawthorn. (*See* Crataegus.)

Hay, Haymaking, *hay* (Sax. *hey*, *hiy*), grass cut and dried for fodder; grass prepared for preservation. Haymaking is the operation of cutting down, drying, and otherwise preparing the forage-grasses and other forage plants. When the plants are in full flower, as they are now supposed to contain the maximum amount of nutritious juices diffused throughout their system, they are mown down with a scythe. Fine, dry weather, when the sun prevails, is generally chosen for the time during which haymaking is to be prosecuted, and the mown material is spread out and tossed over several times for the purpose of exposing it to the sun's rays, even on the first day it is cut. In the evening it is collected into small heaps, which are again spread out to dry the next morning, as on the previous day. If the weather has been very warm and dry, and the sun very powerful, these heaps are carted away and stacked on the third day; but if the weather has been damp, they are again spread out, as previously, until four days have elapsed from the day the grass was cut. The grand object in making hay is to preserve all the colour and natural juices of the grass, &c., which is done by repeatedly turning it over, so as never to expose the [illegible] for any length of time to the influence of the [illegible] stacking hay, these natural qualities are preserved; and besides, a slight fermentation is brought on, which renders the fibres more tender, and dissolves a part of the parenchyma into sugar, which renders the hay more palatable to horses.

Haybote, *hai'-bote* (Sax.), in Law, is a liberty to take thorns and other wood to make and repair hedges, gates, fences, &c., either by a tenant for life or years. It is said to include also wood for the making of rakes and forks used in the making of hay.

Hayward, *hai'-ward* (Sax.), is applied to the keeper of a common herd of cattle of a town, and part of whose duty is to see that they neither break nor crop the hedges of inclosed grounds.

Hazel. (*See* Corylus.)

Head. (*See* Brain, Anatomy.)

Headache, *hed'-ake* (Sax. *heafod*, head; *ace*, ache), or pain in the head, is a complaint of very common occurrence, and may result from so many different causes, that it is impossible to lay down many special directions regarding it. There are few diseases with which it does not occur symptomatically, and it is a prominent symptom in all fevers and inflammations, and in many nervous complaints. It occurs idiopathically, either from weakness or exhaustion of the nerve-power of the brain, or from a disordered state of the digestive apparatus. Sometimes it is an obtuse pain extending over the whole head, with a sense of heaviness, with a general torpitude of the sensorial power, disqualifying the person for continued mental effort. The sight is often dim, the hearing dull, and the memory defective. This arises from some weakness or exhaustion of the brain, and is produced by irregular circulation of blood in the head, by great mental exertion, or by violent mental passions. When it arises from an overloaded condition of the blood-vessels of the brain, there is usually a bloated countenance, full red eye, and a dull inanimate expression. Cold applications to the head, leeches to the temples, or cupping on the back of the neck, with spare diet and active aperients, are the proper means to be adopted in this case. Where it proceeds from nervous exhaustion or nervous irritability, soothing and strengthening measures are to be adopted, and stimulants to be as much as possible avoided. Tonics ought to be employed, and such other means, as out-door exercise, sea-bathing, &c., as tend to strengthen and invigorate the system. Bilious headache, or such as arises from a disordered state of the digestive organs, usually affects one side of the head only, or but a portion of it, most commonly over one eye, and increasing to an acute and often throbbing pain. It is commonly accompanied with a feeling of sickness, often leading to vomiting, and producing extreme languor and depression of spirits. This kind of headache seldom lasts more than a few hours at a time, and may generally be removed by taking a blue bill at bed-time, with a colocynth pill, or other aperient, in the morning. In rheumatic headache, which is commonly caused by exposure to cold, the pain is of a remittent, shifting nature, shooting from point to point, and is felt most at night, when the patient is warm in bed. (*See* Rheumatism.)

Headborough. (*See* Borough.)

Health, *helth* (Ang.-Sax.), is that condition of the living body in which all the vital, natural, and animal functions are performed easily and perfectly, and unattended with pain. It consists in a natural and proper condition and proportion in the functions and structures of the several parts of which the body is composed. From physiology we learn that there are certain relations of these functions and structures to each other, and to external agents, which are most conducive to their well-being and permanency, which constitute the condition of health. States which are deviations from the due balance between the several properties or parts of the animal frame constitute disease. The most perfect state of health is generally

connected with a certain conformation and structure of the bodily organs, and well marked by certain external signs and figures, a well-proportioned body, calm and regular circulation of the blood, free and full respiration, easy digestion, &c. There are, however, few persons who can be said to enjoy perfect health; and hence, in ordinary language, when we speak of health, we imply merely a freedom from actual disease. In this sense, the standard of health is not the same in every individual, that being health in some which would be disease in another. The healthy pulse in adults averages from 70 to 80 per minute, yet there are some in whom 90 or 100 is a healthy pulse. Muscular strength and activity, nervous sensibility, and the sensorial powers, vary exceedingly in different individuals, yet all within the limits of health. There is scarcely any earthly blessing men hold so lightly as health, and yet there is none they so deeply deplore the loss of when deprived of it. In order to preserve health, it is necessary to be temperate in food, exercise, and sleep, and to pay strict attention to bodily cleanliness, abstaining from spiritual liquors and the over-indulgence of sensual gratifications.

HEALTH, BILL OF. (*See* BILL OF HEALTH.)

HEALTH, PUBLIC. (*See* SANITARY SCIENCE.)

HEARING. (*See* EAR, DEAFNESS.)

HEARSAY EVIDENCE, *hear'-say* (Ang.-Sax.), in Law, is the name given to that kind of evidence in which a witness speaks not from his own knowledge, but from what he heard another person say. As a general rule, such evidence is inadmissible in a court of law, as the person by whom the statement was first made cannot be sworn, neither can he be cross-examined; and the full truth or entire meaning of the statement may not have been carried away. But there are some cases in which such evidence is received; as in proof of any general customs, or matters of common tradition or repute; or an account of what deceased persons have said in their lifetime.

HEART, *hart* (Sax. *heort*, Lat. *cor*), in Anat., the great central organ of the circulation of the blood, is a hollow muscular organ in the form of an irregular cone, and placed obliquely in the lower or front part of the thorax, inclined most to the left side. The base is directed towards the spine, and corresponds with the fourth and fifth dorsal vertebræ, while the apex points between the cartilages of the fifth and sixth ribs on the left side. It rests upon the diaphragm, having the lower surface somewhat flattened. It is inclosed in a membranous bag, called the pericardium, but loosely, so as to allow free motion. The heart may be sidered as double, the right side being pulmonary, and serving to transmit blood only to the lungs; the other systemic, forcing the blood into all parts of the system. It contains four cavities,—two at the base, termed auricles, and two at the apex, named ventricles. The right auricle has four apertures,—one from the superior vena cava, by which the blood is returned from the upper portion of the system; one from the inferior vena cava, returning the blood from the lower parts of the system; one from the coronary vein, by which the blood is returned from the heart itself; and one into the right ventricle. The blood passes from the right auricle into the right ventricle, the entrance to which is guarded by a fold of the lining membrane, forming a valve, called the tricuspid, from its presenting three points. The blood is sent from the right ventricle into the pulmonary artery, by means of which it is conveyed to the lungs. The entrance to the pulmonary artery is guarded by three semilunar valves, which prevent the blood from again flowing back into the ventricle. The blood is returned from the lungs to the heart by the pulmonary veins, which convey it into the left auricle. From this it is sent into the left ventricle, the entrance into which is guarded by the mitral, or bicuspid valve, consisting of two pieces, of which the right one is much larger than the other. The left ventricle has its walls much thicker than the right, and forces the blood into the aorta, for distribution over the entire system. At the commencement of the aorta, there are three sigmoid or semilunar valves, as in the pulmonary artery, for preventing the blood from returning. The heart of a fœtus differs from that of an adult, in having a foramen ovale, through which the blood passes from the right auricle to the left. The exterior fibres of the heart are longitudinal, the middle transverse, and the interior oblique. The contraction of the heart is termed systole; its dilatation, diastole.

HEART, DISEASES OF THE.—The heart, from the important part which it plays in the animal economy, is subject to various, serious, and often fatal diseases. Like the other viscera, it is removed from the eye, so that little knowledge of its condition can be obtained by inspection; and hence we must have recourse to other means. The ear is the principal means of obtaining a knowledge of the state of the heart, and by auscultation and percussion (which *see*), we are enabled to detect the existence of various diseases. The heart gives out two sounds, known as the first and second, which are distinguished from each other. The first sound is longer than the second, and the interval between the first and second sounds is shorter than that between the second and first. They have been compared to the two syllables *lupp*, *dupp*. Any manifest alteration in these sounds is indicative of the existence of disease. They may be high or low, clear or dull, muffled, rough, intermittent, &c. Murmurs or regurgitant sounds may arise from disease of the valves. The power of distinguishing between the normal and abnormal sounds of the heart, and of the causes producing the latter, can only be obtained by lengthened experience. Diseases of the heart are usually divided into two classes,—1. functional or nervous, and 2. structural or organic. Chief among the former are palpitations, syncope, or fainting, and angina pectoris (which *see*). They are chiefly to be met with in persons of a naturally nervous temperament, more especially women suffering from hysteria, or other like complaints, and may be induced by great mental excitement. In such cases, great attention should be paid to the general health, and by means of tonics, sea-bathing, and gentle open-air exercise, the system is to be strengthened. Violent exertion, and strong mental excitement, are particularly to be avoided. Among the principal organic diseases to which the heart is subject, are pericarditis, carditis, endocarditis, atrophy, hypertrophy, dilatation, and valvular disease. Pericarditis, or inflammation of the pericardium, may be induced by exposure to damp or cold, or by other causes, which give rise to inflammation in other parts. It is characterized by great tenderness over the region of the heart, amounting, when pressed, to sharp cutting pains, which prevent him from lying upon the left side. If, as is usually the case, the pleura is involved, there will be acute pain on coughing or drawing a deep breath. Sometimes the attack is not so severe, and only a slight pain is felt, or only a sense of heaviness and oppression. Generally the action of the heart is increased, sometimes so much so as to constitute palpitation. Frequently there is a considerable quantity of fluid effused into the cavity of the pericardium, which is sometimes externally visible by the bulging out over that part. It is a frequent attendant of acute rheumatism (which *see*). Its mode of treatment depends very much upon the particular circumstances of each case. Where the disease is rapid and violent, bleeding may be of great service; in other cases tonics, and in some cases stimulants, are employed. Carditis, or inflammation of the heart itself, sometimes occurs, but it is usually accompanied with inflammation of the pericardium: the symptoms in both cases are the same, and the treatment will consequently be similar in both. The like remarks also apply, in great measure, to endocarditis, or inflammation of the interior lining membrane of the heart, which is usually accompanied by one or both of the above. In this case there is more or less of fever and anxiety, and a peculiar sound of the heart is heard upon auscultation. Atrophy, or a wasting of the heart's substance, arises from a deficiency in the supply of nutritive matter. It is usually accompanied by general emaciation, and will be pretty sure to terminate in death. When the heart is examined after death, its tissues are found to have undergone a change, and, instead of a striped, to present a homogeneous appearance. This is called "fatty degeneration." The treatment is to strengthen the system by tonics, wholesome and nutritious diet, open-air exercise, sea-bathing, and the like. Hypertrophy, on the other hand, is the result of an excess of nutrition, the nutritive pro-

cess appearing to go on more rapidly than the absorbent. In this way the heart is often greatly enlarged in bulk, and its operations seriously interfered with. It is usually distinguished into three kinds,—(1) simple, when the walls of the heart, or its divisions, are thickened, without any diminution in the capacity of the cavities; (2) eccentric, or aneurismal, when the walls are thickened, and the cavities likewise enlarged; and, (3) concentric, when the cavities are diminished in proportion to the thickening of the walls. The first of these is the least common, and the second the most frequent; and any of them may affect a single cavity or the whole heart. From the force with which the blood is propelled in such cases being greatly increased, the tendency is to produce hæmorrhages, aneurism of the aorta, apoplexy, &c. The pulsations are frequently regular but strong, sometimes even visibly raising the bedclothes, and the chest is bulged out over the part. Rest, abstinence, and more or less depletion, according to circumstances, are the proper means to be employed in such a case, and usually, with care and perseverance, the symptoms will be much alleviated. Dilatation of the heart is where one or more of the cavities are enlarged in size without the substance of the heart itself being increased. It is sometimes caused by increased action of the heart, and may be produced by excessive exertion or strong excitement of any kind; it frequently also arises from want of sufficient muscular strength in the heart itself, or from some obstruction to the free passage of the blood. It is characterized by want of vigour in the circulation, and by feebleness and inability for exertion in the patient; he will often be exhausted by the loss of even a small quantity of blood, and may even be carried off during a trifling hæmorrhage. Attention to the general health, so as to strengthen the patient and restore the circulation while all exciting causes are to be avoided, are the means to employ in such circumstances. The valves of the heart are subject to a variety of diseases which interfere with their proper action · these are among the most easily detected of the organic diseases, on account of the sounds produced by them. The valves frequently become thickened, or even cartilaginous or osseous, so that they do not act freely, or close imperfectly, leading to obstruction or regurgitation of blood. Being connected with the endocardium, or internal lining membrane, diseases of the valves often result from repeated attacks of endocarditis. These obstructions tend to produce oppressions of the breath, apoplectic fits, sanguineous and serous congestions,—as hæmoptysis, albuminaria, dropsy, &c. The mode of treatment in such cases will depend upon the particular symptoms present, otherwise the general mode of treatment indicated above, of strengthening the tone of the system and equalizing the action of the heart, is to be followed.—*Ref.* Watson's *Lectures on the Practice of Physic;* Copland's *Dictionary of Medicine; English Encyclopædia*—Arts and Sciences.

Heartburn, *hart'-burn* (Lat. *cardialgia*, from Gr. *kardia*, the heart, and *algos*, pain), in Med., is an uneasy sensation in the stomach, ascending with acid eructations and a burning heat into the throat. Sometimes it is attended with oppression, faintness, nausea, and an inclination to vomit, or a plentiful discharge of a clear, lympid, fluid-like saliva, commonly termed waterbrash. In some cases a gnawing or burning pain is felt, chiefly at the cardia, or upper orifice of the stomach; whence the name is derived. It is usually a symptom of dyspepsia, but it may also be occasioned by other complaints; as worms, inflammation of the stomach or intestines, various diseases of the heart, &c. It may also be occasioned by violent emotions of the mind. Indigestible foods, as animal fat, oil, butter, cheese, &c., are very apt to occasion it. The best remedies are alkalies combined with mild aperients, such as magnesia, or tartrate of soda, and rhubarb. The great thing, however, is to restore the healthy action of the stomach, and to avoid such substances as tend to produce it. *(See* Dyspepsia.)

Hearth-money. *(See* Fumage.)

Heat, *heat* (Sax. *heat, hæt*), a term applied in ordinary language either to the sensation excited in us by the approximation of a warm body or to the cause of that sensation. Heat, as a great natural agent, is universally diffused through all matter, and is capable of producing various phenomena; such as expansion, fusion, vaporization, and thermo-electric currents. There is nothing absolutely known as to the cause of heat. The question as to whether it is a substance or an accident has been discussed, without result, since the times of Bacon. By those who consider heat to be a material substance, it is called *caloric*, and is supposed to be a subtle fluid universally diffused, and capable of permeating the densest substances. The parts of this fluid are also supposed to be mutually repulsive, but attracted by the material particles of bodies; thus accounting for expansion and contraction. The other effects of heat are accounted for on principles analogous to those on which the undulatory theory of light is founded. Those who regard heat as merely accidental to matter, consider that the artificial production of heat is accompanied by vibratory motions in the interior molecules of the heated substances. This theory is open to a great objection, for heat is propagated through a vacuum, and even if it is supposed that all space is filled with a fluid, in order to account for solar heat, the hypothesis loses its simplicity, and is very vague. It is better to observe the properties of heat, and from them to measure and calculate its effects, than to speculate on its nature; and instead of using the word *caloric* to conceal our ignorance, to use the word heat, in order to denote that state or condition of a body which excites in us the sensation of heat. Every existing substance may be looked upon as a source of heat. The most important of these is the sun, and its heat, when condensed by means of a lens, is very intense. Without the benign influence of the sun's heat, all nature would be bound in the adamantine chains of cohesion. The conflagration of every combustible on the face of the earth would not compensate for twenty-four hours' absence of the solar rays. The second source of heat is mechanical, and consists in the friction or rubbing together of solid substances. In this operation, strong mechanical force is opposed to the force of cohesion or adhesion, and heat is generated by the reaction of the two. Two pieces of wood rubbed rapidly together quickly become hot, and when the force and velocity are great enough, combustion ensues. The sparks of the common flint and steel are small particles of the metal struck off by the stone, and burning under the influence of the heat elicited by the blow. A third source of heat is chemical. All cases of common combustion, and all artificial processes for obtaining light and heat, are familiar examples of this action. But in all cases of this sort, the heat evolved, however copious and intense, is limited, and proportionate to the quantities of the substances reacting upon one another. Heat is obtained from a fourth source, which is probably allied to the last; namely, electricity. Another source of heat is physiological, and exists in ourselves. Heat is a product of animal life, and we can feel it and judge of it by our own sensations; we can increase it by muscular exertion, and can communicate the sensation of heat to others. When referred to our sensations directly, however, heat and cold become merely comparative terms, and depend upon the temperature of our bodies at the time of experience. Any estimation, therefore, of heat by sensation must be very vague. In all these sources of heat, notwithstanding the copious evolution of the wonderful agent, there is no loss of material substance. Solar heat has been concentrated by a number of powerful lenses on one scale of a balance of extreme sensibility; but no derangement of equilibrium ensued. As far as experiment can show, heat must consequently be looked upon as without weight,—an imponderable agent. Heat radiates from all bodies in straight lines and in all directions; and, like radiant light, its intensity decreases as the square of the distance from the source of the rays · thus, if a thermometer protected from the influence of all disturbing causes be observed to rise a certain number of degrees at one inch distance from a heated surface, it will indicate four times less heat at two inches; nine times less at three inches; and so on. Reflected heat also follows the same law as reflected light; and that the angle of reflection is equal to the angle of incidence may be proved by holding a bright metallic plate before a fire. When we see the reflection of the fire, we also feel the

heat. If two concave mirrors are fixed at a distance of 10 or 15 feet apart, with their axes in the same line, and their faces parallel and opposed to each other, upon placing a thermometer in the focus of one, it will be found sensitive to the effects of a heated body placed in the focus of the other. A piece of ice placed before one mirror will cause the mercury in the thermometer to descend, not through the radiation of cold, but through the radiation of heat from the thermometer to the piece of ice. The best absorbents of heat are the best radiators, and the best reflectors are the worst radiators. The increase of bulk for the same increase of heat varies much in different classes of substances. It is small in solids, larger in liquids, and greatest of all in aëriform bodies. From the freezing to the boiling point of water, 350 cubic inches of lead become 351; 800 cubic inches of iron, 801; and 1,000 cubic inches of glass, 1,001 Liquids augment their volumes in different proportion when subjected to the same change of temperature; but every aëriform substance, provided it be not in contact with a liquid, expands in the same proportion; 1,000 parts of air becoming 1,373, when heated from 32° to 212° Fahrenheit. These expansions take place gradually, and when the heat is withdrawn, the bodies return to their original bulks, by corresponding regular contractions. Accurate measurement and precision of instruments form the perfection of science. The correct measurement of heat cannot be effected by the unassisted senses. But by observing the expansion or enlargement of a certain quantity of air, or of a liquid, or a solid, an apparatus is obtained by which the effects of heat can be accurately measured and calculated. This is the principle of the thermometer. The first invention of this useful instrument is ascribed to Sanctorio, an Italian physician, who lived about 1590. (*See* THERMOMETER.) One of the most important properties of heat is conduction. If a stick of charcoal is held in the flame of a candle, no disagreeable sensation of heat will be perceived, even when the heated extremity is at a small distance from the fingers. But a metallic wire will speedily burn the hand at a greater distance from the extremity, and before any part becomes red even. The process by which the heat is conveyed along the metal is called conduction. This property varies in different solids, and it may be roughly stated that dense bodies possess conductive power in the greatest proportion. Thus, metals are the best conductors; stones are next; hard woods next; and so on. Diamonds and other gems are much better conductors of heat than glass; and thus may be distinguished from it, by touching the lips, which in general are very sensitive to changes of temperature. The gems feel cold, when compared with the glass. The metals themselves vary much in their conducting power. Many useful contrivances for the convenient management of hot bodies are dependent upon the differences of this property; thus wooden handles are used to protect the hand from a hot teakettle, or the handle of a silver teapot is insulated from the body, by the insertion of small plates of ivory, which prevent the conduction of heat to any disagreeable extent. By breaking the cohesion of solids, their conducting power is much decreased. Thus at the siege of Gibraltar, red-hot cannon-balls were carried to the batteries on wooden wheelbarrows, the bottoms of which were covered with layers of sand. Heat is conducted by liquids with such difficulty that some philosophers have doubted whether they are not altogether destitute of the power. They acquire heat, however, under particular circumstances, with such facility, that it might be hastily concluded that they possess the power of conduction in an eminent degree. That liquids conduct heat very imperfectly, can easily be proved by experiment. If a glass tube, four or five inches in length, be nearly filled with water, and the upper part be heated in a spirit-lamp, the water will boil on the surface, while the tube can be held in the hand at the lower end, without inconvenience, as the water is not able to conduct the heat downwards. In all such experiments, however, the heat is ultimately conveyed down the solid sides of the containing vessel. The difficulty of determining the power of conduction in aëriform bodies is much greater than that of liquids. It has never been proved that they are capable of conducting heat at all. A simple experiment will show the comparative powers of conduction of solid, liquid, and aëriform bodies. Metals, when heated to 120°, will severely burn a hand placed upon them, on account of the facility with which the heat travels towards it. Water will not scald, provided the hand be kept without motion in it, till it reaches the temperature of 150°; while the contact of air can be endured at 300°. In the Philosophical Transactions, there is an account of an experiment, by Sir Joseph Banks and some others, who ventured into a room heated to 260°, and remained there for a considerable time without serious inconvenience; and in several processes of manufacturing art, it is necessary for workmen to enter stoves heated as high as 300°, from which no injurious effects follow. The bad conducting power of air is usefully applied for many purposes of convenience, and in the arts. Double doors are put to furnaces, in order to prevent the heat from being conducted outwards; and ice-houses are double-cased, in order to prevent the heat from being conducted inwards. In selecting substances for clothing, the same principles are observed. Articles of dress are warm in proportion to the quantity of air which they contain in their texture. Furs, feathers, wool, and down, retard the passage of heat in this way; and for the same reason, snow preserves the warmth of the earth in frosty weather. Although heat travels by conduction with difficulty through liquid and aëriform bodies, both these classes of substances readily become heated. This is effected by processes of circulation, or rapid change in the relative position of adjacent particles; and the operation is called *convection*. When a liquid is heated, it expands and becomes lighter; the heated and lighter particles rise to the surface, and a new portion comes in contact with the source of heat; and so the motion continues as long as the heat continues to be communicated. The same process of convection takes place, but much more rapidly, in elastic fluids. The expansive and ascensional power of hot air is ordinarily illustrated in the fire-balloon. Montgolfier first applied this power to the construction of a balloon, and Pilatre de Rozier first ventured to float upon the atmosphere in it. (*See* BALLOON.) The ventilation of ordinary rooms, and the ascending currents in chimneys, are both due to the expansion of air by heat. In some of the grand operations of nature, the convection of heat is of great importance. It is principally by the circulation of elastic and non-elastic fluids that the distribution of temperature over the globe is regulated. Thus the heat of the tropics is moderated by the cold currents from the poles; and the low temperature of the Arctic and Antarctic regions is qualified by the warm currents from the equator. The constant current of the trade-winds owes its primary impulse and direction to this cause. The gulf-stream is another instance of the same action. This great current sets across the Atlantic, from the coasts of Africa, towards the shores of the Gulf of Mexico; from thence it passes northwards to the banks of Newfoundland; thus transferring a large portion of warm water to the cold regions of the north. There is a singular exception to the general rule that all substances expand under the influence of heat. This exception is water. When a large body of water, such as that in a deep lake, has been cooled down to 40°, by the perpendicular circulation described, the vertical motion ceases, and the surface water becomes lighter as the temperature falls, finally setting into a sheet of ice. The water underneath is protected from the further influence of the cold, by the cessation of the circulation, and its almost perfect power of non-conduction. If this were not the case in this climate, a lake once frozen could never be liquefied again. Thus far heat has been treated as a force freely developed, which could be measured by our sensations, and by the thermometer and pyrometer. Heat, however, also enters, as it were, into the composition of bodies, loses its character of temperature, and becomes concealed or *latent* to our instruments and our feelings. When equal volumes of the same fluid, at different temperatures, are mixed, they afford the mean temperature of the two. A pint of water at 50°, mixed with a pint at 100°, will show, by the thermometer, a temperature of 75°. If a quantity of mercury, however, at 100°, be mixed with an equal measure of water

at 40°, the resulting temperature will be 60°, or 10° lower than the mean; so that the mercury loses 40°, and the water only gains 20°; yet the water must contain all the heat which the mercury has lost. From this it appears that water has a greater capacity for heat than mercury; viz., it requires a larger quantity of heat to raise it to a given temperature. When matter passes from the solid to the liquid state, or from the liquid to the aëriform state, examples are to be found of *latent heat*. In these processes a large quantity of heat is absorbed, combined, or fixed; and in the opposite changes from aeriform to liquid, and from liquid to solid states, a quantity of heat is set free, and becomes sensible. If equal weights of water at 32° and of water at 212° are mixed, they will show a temperature of 122°; but equal weights of ice at 32° and water at 212° form a mixture, the temperature of which is 52°; the water losing 160° of temperature, while the ice only gains 20°. Therefore, 140° of heat are expended in changing the ice from the solid to the liquid state. Dr. Black, who first investigated these phenomena about the year 1757, drew the conclusion that this portion of heat became latent in the water; which owes its fluid state to its latent heat. The heat is not destroyed or annihilated, as can easily be proved; for if water be exposed to a degree of cold far below the freezing point, it will gradually part with its excess of temperature above that of surrounding bodies, and become colder and colder till it reach the freezing point. The temperature, however, will not descend below 32° till the whole has become ice, and yet it must continue yielding up heat at the same rate as before. There must be, therefore, within it a continued supply of heat, in order to keep it up to the fixed point. Thus the process of thawing ice or snow becomes a gradual one; and without such a provision sudden and disastrous floods would occur every spring in the polar and temperate zones. Artificial cold is easily produced by rapid liquefaction. The mere solution of nitrate of potash alone will lower the temperature of water from 50° to 35°; while a mixture of snow and common salt will cause the thermometer to sink from 32° to zero. (*See* FREEZING MIXTURES.) When liquids pass into the solid state, their latent heat becomes sensible; and by careful management water can be cooled several degrees below its freezing point without congelation; the moment, however, that it is agitated it is made to congeal, and the temperature rises to 32°. The natural processes of vaporization, like that of liquefaction, are gradual and progressive. If this were not the case, the boiling of an ordinary teakettle would be an extremely dangerous operation; for the whole volume of water would otherwise flash into steam in an instant. It is therefore hazardous to boil those liquids which have vapours with a small specific heat. When oil of vitriol is boiled in a retort, sudden explosions of dense vapour burst forth from time to time, and the retort is very liable to be broken by the concussion. When the pressure of the atmosphere is decreased or removed, liquids will boil at lower temperatures. Under the receiver of an air-pump, water may be made to boil at a temperature of 32°; that is to say, the pressure may be reduced till the vapour of water at that temperature, which is of no higher degree of elasticity than would suffice to support a column of mercury in the barometer of 0·20 inch, would be sufficent to remove it; but the full amount of latent heat must be absorbed in its passage into the aëriform state; and as this can be derived from no exterior source, its own free heat enters into combination. The boiling points of liquids are smaller on the summits of mountains than at their bases, in consequence of the diminished elasticity of the air. On the top of Mont Blanc, water boils at a temperature of 187°. When water is converted into vapour or steam by means of heat, it undergoes a much greater expansion of volume than any other liquid. It expands eight times as much as sulphuric ether, and nearly three times and a half as much as alcohol. The working of the steam-engine depends upon the elastic force of steam, communicated by heat and the instantaneous annihilation of that force by cold. The natural temperature of the surface of the globe is affected by so many causes, that it is impossible to calculate the mean heat of any country by its latitude. In the old and new continents, the most rapid decrease of mean temperature is between the parallels of latitude 40° and 45°. This circumstance has had an important influence in the civilization and industry of the people inhabiting that zone; as the slight variations of latitude produce changes in the vegetable productions that become objects of rural economy. When adjacent countries thus differ much in their products, stimulation of industry and vigorous commercial intercourse are the results: civilization is highly advanced by both these circumstances.—*Ref.* Humboldt's *Isothermal Lines and the Distribution of Heat over the Globe.*

HEATH, or HEATHER, *heeth, heth'-er* (Sax. *hath*), in its common signification, means a place or portion of waste land overgrown with shrubs of any kind, or a moor over which the prevailing plants or vegetation consist of one or more of the several species of *heath*, or *erica*. Heaths are common in Scotland, Ireland, some parts of England, and in countries having a similar climate on the continent; and many hundreds of acres are covered with the *erica*, which grows to a height of three or four feet. This plant is used for the purpose of thatching houses, making brooms, &c., and the tops of heather supply generally the place of a mattress in most Highland cottages. In countries, also, where the grass and clover do not begin to grow until late in the spring, the tops of heather, both in a green and dry state, supply forage for horses and cattle. (For a scientific description of the heath-plant itself, the reader is referred to the article ERICACEÆ.)

HEAVEN, *hev'-en* (Sax. *heofen*), a term which designates the region or expanse surrounding the earth, and which appears above and around us like an immense arch or vault, wherein the sun and moon, the planets and the constellations, apparently revolve in their orbits. Amongst the pagans the term *heaven* was applied to the abode of the celestial gods; and Aristotle and others believed the heavens to be composed of incorruptible materials, as likewise the sun, moon, and stars; which belief was a great drawback to the spread of astronomy, until it was overthrown by the reasonings of Galileo. Ancient astronomers also supposed that there were eight heavens, seven of which were named after the planets, and the eighth called the *firmament* (which *see*). The Hebrews acknowledged three heavens;—firstly, the air, or aërial heaven; secondly, the firmament, in which the stars were supposed to be placed; and lastly, the heaven of heavens, or third heaven, which was the seat of Jehovah. Modern astronomy has, however, shown us that the expanse above us is immeasurable space; and in metaphorical language amongst Christians, heaven is held to be the abode of the Deity;—that paradise in which the souls of the good will enjoy happiness, and for ever dwell in the life to come.

HEAVY SPAR, *hev'-e spar*, in Min., a term somewhat loosely applied to both the carbonates and sulphates of baryta and strontia. The true heavy spar of the mineralogist is sulphate of baryta. (*See* CELESTINE, STRONTIANITE, and WITHERITE.)

HEBREW LANGUAGE AND LITERATURE, *he'-brew*.—The Hebrew is one of the oldest and most remarkable of known languages, and is of especial interest to us, as being that in which the Old Testament Scriptures were originally written. It belongs to the so-called Canaanitish branch, or chief division of the Semitic family of languages, the other branches being the Aramaic and Arabian. It is matter of dispute whether the Hebrew language, as seen in the earliest books of the Old Testament, is the dialect which Abraham brought with him into Canaan, or whether it is the common tongue of the Canaanitish nations, which Abraham only adopted from them, and which was afterwards developed to greater fulness under the peculiar moral and political influences to which his posterity were exposed. There is every reason to believe, however, that Abraham, on his entrance into Canaan, found the language then prevailing among the different tribes inhabiting that country to be in, at least, dialectical affinity with his own. For a long time, down to very recently, Hebrew was universally regarded as the original language of the human race, coeval with its beginning; and that traces of it were discoverable in all subsequent tongues. The origin

and progress of the Hebrew language, until it became the language of Scripture, in the time of Moses, it is impossible to determine. According to some, the vernacular dialect of Abraham himself was Aramaic, and became gradually changed by the influx of Egyptian and Arabic words, to the time of Moses. From the time of Moses down to the Captivity, a period of a thousand years, notwithstanding the existence of some isolated, but important archaisms, as in the form of the pronoun, &c., it underwent but little change. So far is this the case, that it has been used as an argument against the received antiquity of the Pentateuch. The causes, however, are to be sought in the isolated and stationary character of the Hebrews themselves, and the genius of the language, as little susceptible of change. In even the earliest canonical books of this period, the language appears in a state of mature development, with precision of syntactical arrangement and great regularity of formation. One of the most remarkable features in the later language of this period is the difference which distinguishes the diction of poetry from that of prose. The language of simple narration and history limits itself to the forms necessary to common purposes; the poets, on the other hand, made use of unusual words and flexions, and harmonic arrangement of thoughts, as seen both in the parallelism of members in a single verse, and in the strophic order of longer periods. The rhetorical language of the prophets moves in a more free rhythm of thought, and in longer sentences, than the poets; but, in other respects, especially in its palmy state, falls in very much with it. The decline and corruption of the Hebrew language dates from the Babylonish captivity. From the time of the Assyrians the Aramaic made great inroads upon the Hebrew; and after the power of the Israelites had been broken by long wars and captivity, the Aramaic, owing to the influence of foreign authority and foreign colonists, spread rapidly. After their return from the captivity, Ezra and Nehemiah took care that the Hebrew, in its ancient form, should be made more familiar to the people; and they both wrote in Hebrew. Among the more strict Jews, the Hebrew was still retained, although within narrow limits, as appears from Daniel and the Maccabees. Still the progress of the Aramaic was not to be repressed; and if the ancient language was occasionally imitated, there was always a considerable admixture of the foreign idiom. From the second century on, the Hebrew was known only to the learned, whilst the Aramaic became the vernacular of the country. Yet, after it ceased to be the language of the people, it did not become unknown to them, as it was read in the Bible in the synagogues, and was frequently made use of by the learned among them to communicate information to those of their own faith. The earliest known character in the Hebrew writing bears a very strong resemblance to the Samaritan, both being evidently derived from the Phœnician. During the Babylonish captivity, they received from the Chaldees the square character in common use; and in the time of Ezra, the old Hebrew manuscripts were copied in Chaldee characters. The origin of the vowel-points is usually assigned to the seventh century of our era, and arose from the efforts made by the learned Jews to preserve the pronunciation of their sacred language, when it ceased to be a spoken tongue. The minute and complex system which we now possess was gradually developed, from a few indispensable signs, to its present elaborateness. There are three kinds of Hebrew alphabets now in use, —the square, or Assyrian, that commonly used in print; the rabbinical, or mediæval, that used chiefly in commentaries and notes; and the cursive, which is employed in writing. There are no capital letters, and the writing is from right to left. The alphabet consists of twenty letters, or consonants, the vowels being expressed by marks above or below the letters. Five letters have a separate final form. The accents and marks of punctuation are very numerous. The Hebrew is deficient in grammatical technicalities, especially in moods and tenses of the verb, and, consequently, also somewhat in precision; but in euphony, simplicity, brevity, variety of signification, and power of poetical expression, it is hardly excelled by any tongue. The Hebrew literature is the oldest in existence, and has claimed a high degree of attention on account of its connection with our religion. With the Hebrews, as with every other people, poetry was cultivated before prose; and in the songs of Moses and Deborah we have the earliest specimens of poetry. The Jews were pre-eminently a musical people. Everything calculated to excite the multitude was expressed in song; and young men and maidens emulated each other in beautiful odes at their festive gatherings. The art of poetry was taught in the schools, and their religious exercises and worship were always conducted with singing and instrumental performances. Hebrew poetry is remarkable for its wealth of imagery, not only in the way of illustration, but also of metaphor, substituting the image for the object to be described. There is also a great desire for the symbolic, giving to abstract ideas a concrete form, and investing even inanimate objects with thoughts, feelings, and speech. Hebrew poetry is sententious, each stanza or couplet being complete in itself; so that they would admit of increase or diminution, or of a different arrangement, without destroying the unity of the whole. The poetry of the Hebrews formed so much the groundwork of their higher thinking, that it gave colouring to their historical writings, and affected their philosophical speculations. Hence arose those anthropomorphisms which to us are frequently so offensive, but which naturally connect themselves with the religious views of the Hebrews. One peculiarity of their poetry is *parallelism*, or the regularly placing beside each other symmetrically-constructed propositions. The symmetry, however, is not so much external as ideal, being the same thought repeated several times in other words, or apprehended antithetically from opposite sides. All attempts to discover rhyme or metre in ancient Hebrew poetry have failed; but this may probably arise from our ignorance of the ancient pronunciation. Lyric poetry prevailed under the poet king David, who was equally successful in song and elegy. Strong religious feelings distinguish the spirit and subject of these poems. On the other hand, Solomon in his actions, as well as in the writings which bear his name, inclines evidently to a philosophic and even worldly spirit, very remote from the Jewish character. After the division of the kingdom, religion and literature alone preserved a residue of national vigour, and the prophets now became the instructors and comforters of this morally and politically degraded people. Before the unfortunate period of the Babylonish captivity, under the kings lived Jonah, Joel, Amos, Hosea, Isaiah, Micah, Obadiah, Nahum, and Habakkuk. During the captivity flourished Jeremiah, Ezekiel, Daniel, Zephaniah; and after the return, Haggai, Zechariah, and Malachi. That much must have been lost from the treasures of Hebrew literature, which was very rich, particularly in the age of Solomon, is evident from passages in the Old Testament itself. Of many of the works of the prophets, particularly those known as the minor prophets, we evidently possess only fragments. The period immediately after the return from the Babylonish captivity was of the highest importance to Hebrew literature. Learned men were appointed to make collections of the ancient writings, and the sacred Scriptures were authenticated, and arranged into a canon. When Judea was a province under the successors of the Macedonian hero, Greek refinement, science, and philosophy, spread among the Jews, and a number of errors crept into their religion, and led to the formation of different sects among them; as the Pharisees, Sadducees, Essenes, &c. The Greek language became common in Judea, and the Septuagint was used in the synagogues. During this period, and under the Romans, their literature made great progress, from the influence of the great successive schools, the most famous of which was that of the great Hillel, president of the Sanhedrim. The philosophical book of Ben Sirach and the first book of the Maccabees are the products of the earlier part of this period; and a number of the other apocryphal writings, whose date is unknown, may probably be referred to the same time. The simultaneous literary activity of the Jews in Africa is evinced by their numerous contributions to Hellenistic poetry and history (Jason, Alexander, Polyhistor, Ezekiel, &c.), and especially to Platonic philosophy (Aristobulus, Philo, &c.). The Roman

conquest and the persecutions which followed naturally exerted a very pernicious effect upon literature. After the desolation of Jerusalem, various other places in Palestine became distinguished for their schools of religious science, principally under the lead of the presidents of the Sanhe- [illegible] system- [illegible] of the oral [illegible] finally converted into a written code, or compendium of teachings (Mishna), by the patriarch Jehudah the Holy, and his school, during the mild reign of the Antonines. To this were added the partly supplementary, partly explanatory works, Tosefta, Mekhilta, Safra, and Sifre. These works became the basis of religious study in the subsequent three centuries, in Palestine, as well as in Babylonia, where various flourishing schools existed. After new persecutions by the Christian emperors, which destroyed the schools (353) and the patriarchate (429) of Palestine, and by the Persian kings in the latter part of the 5th century, which destroyed the schools of Babylonia, the results of these studies were collected, though in chaotic disorder, in the two Gemaras or Talmuds (which *see*), the Palestinian and Babylonian; other extant products of the time were various ethical treatises; historical, legendary, and cosmogonal writings; stories, prayers, &c. The Chaldee, often with an admixture of Hebrew, was now generally used in literary works, while the people used the various languages of the countries in which they lived. Under Mohammedan rule, particularly under the later caliphs, who favoured science, the Jews enjoyed comparatively mild treatment, and their schools revived, particularly in Babylonia. Numerous works, historical and ethical, were composed; the critical notes of the Masora, and the Targum of Jerusalem elaborated; talmudical compendiums written; and medical, astronomical, and linguistic studies pursued. Scientific and literary pursuits also flourished among the Jews in Africa, who, with slight interruptions, enjoyed peace under the Saracenic princes. The Arabic was [illegible] fe[illegible] bu[illegible] the most cruel persecutions. In Spain, however, under the Moorish princes, they enjoyed civil rights, and nearly to the same extent under the Christian kings; and here they made great progress in literature and science. The most distinguished man of this time was Moses Maimonides, renowned as a philosopher, as well as a writer on law. Since that time the Jews have advanced with the surrounding nations, and have produced a number of distinguished men in almost every department of literature and science.—*Ref.* Kitto's *Biblical Cyclopædia*; Herzog's *Theological Encyclopædia*; the *New American Cyclopædia*; Brockhaus's *Conversations Lexikon*, and the numerous works therein referred to.

HEBREWS, EPISTLE TO THE.—The name of one of the canonical books of the New Testament addressed to converted Jews, and designed to dissuade them from relapsing into Judaism, and to fortify them in the Christian faith. It contrasts the grandeur, efficiency, and perpetuity of the new covenant economy with the earthliness, feebleness, and temporary nature of the Mosaic; and exhibits the divine character and offices of the Redeemer, and his infinite superiority to Moses and the Aaronic priesthood. The reasonings are interspersed with numerous solemn and affectionate warnings and exhortations, addressed to different descriptions of persons. It consists of three parts:—1. demonstrates the deity of Christ by the explicit declarations of Scripture (i.—x. 18); 2. the application of the preceding arguments and proofs (x. 19—xiii. 19); and 3. the conclusion, containing a prayer for the Hebrews and apostolic salutations (xiii. 20—25). In the first part, the proposition is that Christ is true God (i. 1—3), and the proofs are: 1. his superiority to angels, by whom he is worshipped as their Creator and Lord (i. 4—14), therefore we ought to give heed to him (ii. 1—4); the superiority over angels asserted, notwithstanding his temporary humiliation, in our nature (5—9); without which he could not have accomplished the work of man's redemption (10—15); for which purpose he took not upon him the nature of angels, but that of the Abraham (16—18). 2. His superiority to Moses, only a servant, whereas Christ is Lord (iii. 1—[illegible] argument applied to the believing Hebrews, [illegible] exhorted not to copy the example of their [illegible]ing ancestors who perished in the wilderness (iii.—iv. 13). 3. His superiority to Aaron and all the [illegible] high priests demonstrated, he being the true priest adumbrated by Melchisedek and Aaron (iv. 14—viii.). 4. The typical nature of the tabernacle and its furniture, and of the ordinances there observed (ix. 1—10). 5. The sacrifice of Christ is that true and only sacrifice by which all the Levitical sacrifices are abolished (ix. 11—x. 18). In the second part the Hebrews are exhorted—1. to faith, prayer, and constancy in the gospel (x. 19—25), enforced by representations of the danger of wilfully renouncing Christ after having received the knowledge of the truth, interspersed with warnings, expostulations, and encouragements (x. 26—xi.); 2. to patience and diligence in their Christian course, from the testimony of former believers, and by giving particular attention to the example of Christ (xii. 1—13); 3. to peace and holiness, and to a jealous watchfulness over themselves and each other, enforced by the case of Esau (xii. 14—17); 4. to an obedient reception of the gospel and a reverential worship of God, from the superior excellency of the Christian dispensation, and the proportionably greater guilt and danger of neglecting it (xii. 18—29); 5. to brotherly love, hospitality, and compassion, charity, contentment, and the love of God (xiii. 1—3); 6. to recollect the faith and examples of their deceased pastors (4—8); 7. to watchfulness against false doctrines in regard to the sacrifice of Christ (9—12); 8. to willingness to bear reproach for him, and thanksgiving to God (xiii. 13—15); 9. to subjection to their pastors and prayer for the apostle. The authorship of this epistle has been much disputed in early, as well as in recent times, though the weight of evidence, both external and internal, greatly preponderates in favour of St. Paul. It has also been ascribed to Apollos, Silas, Clement, Luke, Barnabas, &c. It was probably written about A.D. 62 or 63. The language in which it was originally written; the Jews to whom it was addressed; whether it really was an epistle addressed to a particular community, or only a discourse or dissertation intended for general readers, have all been matters of dispute.—*Ref.* Horne's *Introduction to the Holy Scriptures.*

HECATOMB, *hek'-ă-toomb* (Gr. *hekatombe*, from *hekaton*, a hundred; *bous*, an ox), in Grecian Antiq., a sumptuous or magnificent sacrifice; originally consisting of the sacrifice of a hundred beasts of the same kind, at a hundred altars, by a hundred priests or sacrificers. Pythagoras is said to have sacrificed a hecatomb of a hundred oxen to the muses, in joy and gratitude for his having discovered the demonstration of the 47th proposition of the first book of Euclid. Although a true hecatomb consisted of a hundred oxen, yet, in the time of Homer, the word had lost its real etymological meaning: it merely meant a great public sacrifice. Thus, in the Iliad, an allusion is made to a hecatomb of twelve oxen; to another of oxen and rams; and to another of fifty.

HECTIC FEVER, *hek'-tik* (Gr. *hektikos*, habitual), in Med., is employed to denote a protracted or habitual fever, and is generally applied to that intermittent fever which usually occurs in the latter stages of consumption. It is commonly characterized by morning and evening paroxysms, with intermediate remissions; but the evening paroxysm is usually the most marked. Towards evening, as the paroxysm comes on, the listless, languid manner which prevailed during the day becomes changed, the eyes brighten, the conversation becomes animated, and the cheeks assume a beautiful flush. This may continue for five or six hours, when the manner and appearance of the patient become entirely changed, the hectic flush passes away, and a chill spreads over the entire frame, followed by a profuse perspiration, which leaves the patient utterly prostrate. Day after day the sad story is repeated, the patient is gradually reduced in body and strength, and at length dies exhausted. (*See* CONSUMPTION.)

HEDEOMA, *he-de-o'-mă* (Gr. *edus*, sweet), in Bot., a gen. of the nat. ord. *Labiatæ*. The species *H. pulegioides*, commonly known as American pennyroyal, is

in the [illegible] tern states of America as an [illegible] occasionally as a stimulant and carminative.

Hedera, *hed'-e-rä* (Lat., ivy), in Bot., the Ivy, a gen. of the nat. ord. *Araliaceæ*. *H. Helix* is the well-known climbing evergreen which grows over old trees and walls. The gardeners of the last century frequently trained it into fanciful shapes, as of human figures and birds, on skeletons of wire-work. Its black berries increase during the winter, and ripen in April, furnishing food for wild pigeons and song-birds in the spring. Sheep eat the leaves in severe weather. Medicinally, the ivy is reputed to be diaphoretic, and its berries are emetic and purgative.

Hedge, *hedj* (Sax. *hege*), the best class of fence that we have, with the exception of a stone or brick wall, and one of the most lasting safeguards against trespassers. A hedge is constructed of most kinds of trees and shrubs, but the best is, undoubtedly, one which is made of shrubs of a thorny nature, and of these, *holly* is the best plant for the purpose. The method of procedure by which hedges are formed is very simple, and consists, after the trees or shrubs have been planted, in cutting off their tops, and shortening the side branches, by which means an undergrowth of smaller branches is obtained, and the hedge made thick and spreading; a compact mass of vegetation spreading in every direction, and nearly impenetrable. With *holly hedges*, however, more pains must be taken, as the ground has to be carefully prepared by manuring and trenching; the holly-shoots must also be judiciously planted after midsummer, when the soil is moist from recent rain-falls, and a convenient space must be left between the plants, in order to enable them to spread their roots, and derive ample nourishment from the soil. On account of its slow growth, holly takes a long time to mature into a good hedge, and consequently it is not so often used for the purpose as it would otherwise be. Yew forms a close and durable hedge, when well and carefully clipped, and for gardens and nursery-grounds, where shade is required as well as protection, a yew hedge is preferable to any other. Beech, lime, and hornbeam are used when high hedges and strong fences are required; also elder, which is such a rapid grower, that a complete hedge is soon obtained after planting: it has also got another merit, and that is, that cattle do not eat its branches. In gardens, *privet hedges* are more common than those composed of other shrubs, and in fields and grounds, the black and white thorns are by far the hedges which are most generally adopted. In France and Holland, hedges are often trained along stakes and rods, which have been placed for the purpose: these hedges have a very light and pleasing effect, from their neatness and regularity. The *English Encyclopædia*, in concluding an elaborate article on this subject, observes: "Well-managed hedges are the most effective fences, the cheapest, and the most pleasing to the eye. It is to the hedgerows that England owes much of its garden-like appearance." (*See* also article Fence.)

Hedgehog, *hedj'-hog* (*Erinaceus europæus*), a gen. of animals belonging to the class *Mammalia*, ord. *Feræ*, and fam. *Talpidæ*. It is found in most parts of Europe and Asia, and also in South Africa, from which latter country a specimen of the *Erinaceus frontalis* has been placed in the British Museum. The hedgehog is known by its body being covered with spines, and its possessing the faculty of rolling itself up into a ball, protected by these same spines, when pursued; and it will not disengage itself until the danger has passed. It is generally about nine inches in length, its muzzle is pointed; its tail short; the head very conical; ears short, broad, and rounded; each foot five-toed, and armed with long claws; eyes prominent; body oblong, and conical on its upper surface; and its legs are short, and nearly destitute of any covering. Its colour is usually of a greyish-brown; and it is a nocturnal animal, while in the winter it burrows in the earth and becomes torpid. Its usual food is composed of beetles, slugs, and snails; and from its fondness for insects, and its nocturnal habits, it is often domesticated in London to destroy cockroaches and black-beetles. A foolish idea at one time prevailed, that the hedgehog was in the habit of sucking the udders of cows during the night-time, which is naturally without foundation. Another charge is also laid against this little animal, as it is said to be a great destroyer

of the eggs of game-birds. Its flesh is well-flavoured, and it is eaten on the continent, although few but gypsies consume it in England.

Hedge Hyssop. (*See* Gratiola.)

Hegira, *hej'-i-rah* (Arab. *hajara*, I remove, fly), the era from which Mahometan nations compute all chronological events subsequent to the flight of Mahomet from Mecca to Medina, on the night of the 15th of July, 622. The first day of the first year of the Hegira is, therefore, the 16th of July in that year. As there are only 354 days in the Mahometan year, it follows that thirty-three of their years are very nearly equivalent to thirty-two years according to our system of reckoning. We must, therefore, in bringing any date reckoned from the Hegira to its corresponding date according to the Christian era, subtract three years for every hundred years contained in it, or, to speak more accurately, one year for every thirty-three years, and then add to the result the number of the year of our Lord in which the hegira took place, less one; and in converting a date of the Christian era into its corresponding date reckoning from the Hegira, we must reverse the process, subtracting the number of the year in which the Hegira took place, less one, from it, and adding to the result one year for every thirty-two years contained in it. Thus, if we require the year of our Lord in which the year of the Hegira 1280 commences, we must subtract 39 from it, or 1 for every entire thirty-three years, and add 621 to the result, 1242, which gives 1863. If, on the other hand, we require the year of the Hegira that commences in 1863, we must subtract 621 from this amount, and to the result, 1242, add one year for every entire thirty-two years contained in it, which gives 1280.

Heidelberg Catechism, *hi'-del-berg*, is the name of a work which occupies an important place in the history of the Reformation. It was the joint production of Caspar Olevianus and Zacharias Ursinus, professors of theology in the university of Heidelberg; and its publication and use was ordered by decree of elector Frederick III., dated 19th January, 1563. The elector, to prevent the religious bickerings that had disturbed the first year of his reign, and feeling it his duty to provide for the religious wants of the people, caused it to be introduced into both church and schools. This catechism agrees with the theology of the Reformed church in general, and with that of the Calvinistic type in particular. Princes and theologians set themselves in array against it, the Roman Catholics detested it, the Lutherans assailed it, the Melanchthonian theologians of Wittemburg combated it; but the elector stood firm, and the catechism held its place.—*Ref.* Herzog's *Theological Encyclopædia*.

Heights, Measurement of, *hites* (Ang.-Sax.).—The measurement of elevations above the surface of the earth, or above the level of the sea, may be effected in four different ways: firstly, by trigonometrical calculations and measurements; secondly, by levelling;

thirdly, by means of the barometer; and lastly, observing the difference of temperature at which liquids will boil at different heights. (*See* BOILING-POINTS.) The means used to ascertain the heights objects by the first and second methods named abo are described elsewhere. (*See* LEVELLING, MENSURATION, TRIGONOMETRY.) In measuring heights by the barometer, the principles of which are explained in the article on that instrument (*see* BAROMETER), the differences of temperature and of the force of gravity at different elevations, which must be carefully registered and allowed for in correcting the results obtained by such an operation, if great nicety be required, render it a task of considerable difficulty, involving numerical calculations of great intricacy. Supposing, however, that the heights of the column of mercury in a barometer at two different elevations have been ascertained, the following rule, which has been laid down by Professor Leslie, for computing the difference of height in the elevations, will give a result sufficiently near for all practical purposes:—"As the sum of the heights of the mercurial columns is to their difference, so is 52,000 to the approximate height in English feet." To exemplify this rule, considering the height of the barometer at the sea-level to be 30 inches in round numbers, and assuming it to be only 27 inches at the top of a mountain, we get the following proportionals:—30 + 27 : 3 :: 52,000 : the height of the mountain in English feet, or the height of the mountain = 52,000 × 3 ÷ 57 = 2,737 feet nearly.—Ref. *English Cyclopædia*—Arts and Sciences; *Astronomical Society's Transactions*, vol. i.

HEIMSKRINGLA, *hims'-kring-lă* (Icelandic, the circle of the earth), the name given to the greatest work written by Snorro Sturleson, the last of the northern Scalds, who lived in the beginning of the 13th century. He himself called the book the "Saga, or Story of the Kings of Norway," and the term *heimskringla* was bestowed upon it on account of that word being the first prominent one in the old Scaldic manuscript of Snorro. The work is a connected series of memoirs of the kings and mighty men of the Scandinavian peninsula, Denmark, and England, from an almost mythological period down to his own time. It is written in a spirited and fascinating way, by a man who could recall vividly, and describe graphically, the scenes which passed before his imagination. Historical incidents, speeches, and anecdotes, constitute the work, interspersed with rude snatches of Scaldic song. These verses are evidently introduced by the author as a species of rough ornament, and at the same time to heighten the general effect of the narrative. In 1230, Sturla, the nephew of Snorro, made a copy of the *Heimskringla*, which is considered to be the most authentic text of the work. As late as 1567, copies were made of this manuscript. In 1844, Samuel Laing translated the *Heimskringla* into English, with a preliminary dissertation on the intellectual and social condition of the Northmen. The study of this work is calculated to put the English reader in a position to judge of the influence which the social arrangements and spirit of the Northmen may have had upon the character and free institutions of this nation.—Ref. *The Heimskringla; or, Chronicle of the Kings of Norway*, translated by Samuel Laing.

HEIR, *aire* (Lat. *hæres*, old Fr. *heire*), in Eng. Law, is one who succeeds, by descent, to an estate of inheritance, being lands, tenements, or hereditaments. The estate must be a fee, because nothing passes *jure hæreditatis* but a fee; and the word "heirs" is necessary in the grant or donation, in order to make a fee or inheritance. In the Scotch law the term heir does not mean merely the heir-at-law, but also the heir by destination or limitation; neither is it confined to lands only, but is applied also to the successors to personal property, who are, in the English law, distinguished as next of kin. There are different kinds of heirs; as (1), heir-general, or heir-at-law, he who, after his father or ancestor's death, has a right to inherit all his lands, tenements, and hereditaments; (2) heir-apparent is he whose right of inheritance is indefeasible, provided he outlive the ancestor; as the eldest son, who must, by the course of the common law, be heir to his father on his death; (3) heir-presumptive, is one who, if the ancestor should die immediately, would, in the present circumstances of things, be his heir, but whose right of inheritance may be defeated by the contingency of some nearer heir being born,—as a brother or nephew, whose presumptive succession may be destroyed by the birth of a child; or a daughter, whose hopes of succession may be hereafter cut off by the birth of a son; (4) heir by custom, he whose right of inheritance depends upon a particular and local custom; as in borough-English lands the youngest son succeeds to his father, while in gavelkind lands all the sons inherit as parceners, and make but one heir; (5) heir by devise, or *hæres factus*, he who is made by will the testator's heir or devisee, and has no other right or interest than the will gives him; (6) heir special, is the issue upon whom an estate is entailed,—they may be either general or special, born of a particular mother, and these may be either male or female; (7) heir of blood and inheritance (*hæres sanguinis et hæreditatis*), is a son who may be defeated of his inheritance by his father's displeasure; (8) *ultimus hæres*, is he to whom lands come by escheat or forfeiture, for want of proper heirs, or on account of treason or felony; being either the lord of the manor or the crown. The eldest son, after the death of his father, is at common law his heir. The estate claimed by the heir must necessarily be one that remained in the ancestor or deceased owner at the time of his death, and of which he has made no testamentary disposition. The word heir is a *nomen collectum*, and extends unto all heirs; and, under heirs, the heirs of heirs are comprehended *in infinitum*. (*See* DESCENT.)

HEIRESS, in Law, is a female heir. Where there are several, they are called co-heiresses.

HEIRLOOM, in Law, is a term applied to such goods and personal chattels as, contrary to the nature of chattels, go by the special custom of a particular place to the heir, together with the inheritance, and not to the executors or administrators. They are usually carriages, implements, utensils, &c.; and though mere chattels, they cannot be devised away from the heir by will; any such devise being void, even by a tenant in fee-simple. The owner, however, is of course at liberty to sell or dispose of them during his life, as he may see meet. The term heirloom is frequently applied to such chattels as are sometimes directed by the testator to go to the heir, together with the inheritance; as pictures, plate, &c. But the term is not here used in its strict and proper sense, and the same rules do not absolutely apply; for such a destination is not valid against the claims of creditors; and on the death of the heir intestate, will pass, like other chattels, to his personal representatives, and not to his heir. The word "loom" is of Saxon origin, and signifies limb, or member; an heirloom being thus a limb or member of an inheritance.

HEISTERIA, *hi-ste'-re-ă*, a gen. of West-Indian plants, consisting of trees with alternate leaves and small axillary flowers. It received its name in honour of Laurence Heister, of Helmstadt. Class *Decandria*, order *Monogynia*. It is often said that the wood of *Heisteria coccinea* is the partridge-wood of the cabinet-makers; but this appears to be a mistake. In the corrupt French of Martinique, the wood of the *Heisteria* is called *bois perdrix*, a name not signifying partridge-wood, but partridge-pea, *bois* being used for *pois*. It is so called on account of the wild pigeons being fond of the berry.

HELIACAL, *he-li'-ă-kăl* (Gr. *helios*, the sun).—When a star appears above the horizon, and becomes visible a short time before sunrise, its rising is said to be heliacal. In the case of a star that is close to the sun's orbit when the sun, by reason of its course along its orbit, is approaching the star, the sun rises after the star, and sets after it; but when the sun has passed the star, and is receding from it, the star begins to rise before the sun, and sets before it. When the sun is close to the star in its rising and setting, or when both bodies rise and set very nearly at the same time, the latter cannot be seen on account of the superior brilliancy of the former. When, therefore, the sun is approaching the star, and the star becomes visible at its setting, just after sunset, it is said to set heliacally; but when the sun has passed the star, and it is visible at its rising shortly before sunrise, it is said to rise "..."

HELIANTHUS, *he-le-an'-thus* (Gr. *helios*, the sun, *anthos*, flower), in Bot., the Sunflower, a gen. of the nat. ord. *Compositæ*. The species *H. annuus* is a well-known annual. It is appropriately named the sunflower, as its large circular head of florets, surrounded by golden rays, forms a complete ideal representation of the sun; moreover, it never ceases to adore the sun while the earth is illuminated by his light; for when he sinks in the west, the flowers of *Helianthus* are turned towards him, and when he rises in the east, they are ready to be cherished by the first beams. Some writers on botany deny that the flowers turn with the sun; but their observations do not agree with popular experience. There are varieties of *H. annuus* with double flowers, the tubular florets being all changed into ligulate ones, like those of the ray. The pith of the stem contains nitrate of potash, and is sometimes used in the preparation of moxas. The fruits have lately been employed as an ingredient in a kind of soap, called sunflower soap. The species *H. tuberosus* produce the tubers known as *Jerusalem artichokes*, which are much eaten, like potatoes. The word Jerusalem is merely a corruption of the Italian *girasole*.

HELIOCENTRIC. (*See* GEOCENTRIC.)

HELIOMETER, *he-le-om'-e-ter* (Gr. *helios*, the sun, and *metrein*, to measure), an instrument invented by the astronomer and mathematician Bougner, about the middle of the 18th century, for the purpose of determining the diameter of the sun, moon, and stars. It consists of a conical tube, fitted with two object-glasses of the same focal length, or a single object-glass divided into two equal parts, which are made to slide along each other in the line of section, by micrometer screws, in connection with graduated scales. The glasses are contrived to move in a direction at right angles to the axis of the tube. When the heliometer is directed towards any heavenly body, two images are formed in the eye-glass of the instrument, which may be made to separate entirely from each other or coincide, at pleasure, by moving the object-glasses by the micrometer screw. When the images coincide, the angle subtended by the diameter of the heavenly body under observation is equal to that which is subtended by the distance between the centres of the object-glasses; and as this angle and the distance between the centres of the glasses are determinable by the graduated scales attached to the instrument, the diameter of the heavenly body can be determined when its distance from the observer is known, or, *vice versâ*, its distance can be determined if its diameter be known.

HELIOSCOPE, *he'-le-os-kope* (Gr. *helios*, the sun, and *skopein*, to observe), a telescope fitted with coloured glasses, or having the inner side of the eyeglass blackened by holding it over the flame of a candle, that the sun may be observed without injury to the eye of the observer, from the brilliancy of its rays. In observing an eclipse of the sun, the eye is similarly preserved from injury by looking at the phenomenon through a piece of smoked or coloured glass.

HELIOTROPE, *he'-le-o-trope* (Gr. *helios*, the sun; *trepeo*, I turn), an instrument by means of which the sun's rays can be reflected to a considerable distance. It is used in trigonometrical surveys to transmit signals from one station to another, and to render distant stations distinguishable when they are many miles apart, that the surveyor may be enabled to determine his angular measurements with accuracy. (*See* GEODESY.)

HELIOTROPIUM, *he-le-o-tro'-pe-um* (Gr. *helios*, the sun; *trepeo*, I turn), in Bot., the Heliotrope, or Turnsole, a gen. of the nat. ord. *Boraginaceæ*. *H. peruvianum* and *europæum* are popular plants. They have a delicious odour, not unlike that of new hay.

HELIX, *he'-liks* (Gr. *helix*, a wreath or circumvolution, from *helissein*, to wind round, enviro), part of a spiral line, consisting of an entire turn of the thread of a screw round the central cylinder. In Arch., the term is applied to the small volutes introduced under the flowers of the Corinthian capital, which are also called *urillæ*. A winding staircase, such as is commonly attached to the towers of churches to afford the means of access to the summit, is sometimes called a *helical* staircase, in contradistinction to a spiral staircase, which winds round a cone, the circumvolutions continually decreasing in diameter and approaching nearer to the axis. In Anat., the auricle or outer part of the ear is so called; and, in Zool., the snail, from the peculiar shape of its shell, which consists of a single spiral valve.

HELLEBORE. (*See* HELLEBORUS.)

HELLEBORUS, *hel-leb'-o-rus* (Gr.), in Bot., a gen. of the nat. ord. *Ranunculaceæ*, consisting of perennial herbs with palmately- or pedately-divided leaves, of a paler green and more rigid than in most other plants of the order. The most important species is *H. niger*, the black hellebore, so called from the colour of its roots. It is a native of the shady woods of the lower mountains in many parts of Europe. It flowers in winter, and on this account is sometimes called the white Christmas rose. Hellebore root is imported in bags and barrels from Hamburg, and is used medicinally as a drastic purgative. The species *H. officinalis viridis* and *fœtidus* possess similar properties. The two latter have been found wild in several parts of England. The derivation of the term is from the Gr. *helein*, to destroy, and *bora*, food for cattle; because, on account of its poisonous qualities, it is unfit to be eaten by cattle.

HELMET, *hel'-met* (Low Lat. *helmus*, Ital. *elmetto*), a piece of defensive armour for the head, which has been worn by the soldiers of all nations from the earliest ages. The oldest form of the helmet seems to have been that of a conical cap of metal, with a piece projecting downwards from the rim in front, called a nasal, that protected the face. Goliath of Gath is mentioned in the sacred writings as wearing a helmet of brass. The Egyptians wore helmets of quilted linen, as well as those of metal. The Greeks and Romans wore them in the form of a round skull-cap, with a ridge of metal rising along the centre, from the front to the back, which was ornamented with a fringe or crest of horsehair. Some of these helmets had broad triangular nasals, covering the whole of the upper part of the face, and narrowing gradually to a point at the chin, with holes for the eyes of the wearers. In ancient sculptures, Minerva is often depicted as wearing one of this kind, pushed back to expose the face, with the nasal resting on the upper part of the face. The Anglo-Saxons generally wore helmets of leather, strengthened with a metal ring; the nobility having them of metal in the form of a cone, with a small projecting nasal. The helmet of the Saxon monarch, called the *cynehealm*, or royal helm, was the emblem of his rank, like the crown, and is sometimes represented with a coronet surrounding it. The same kind of conical helmet, with the nasal, was also worn by the Danes, and subsequently by the Norman soldiers, at the time of the Conquest, and after that event, as may be seen in representations of the Bayeux tapestry, and other works of art executed in the 11th and 12th centuries. Little change seems to have been made in the form of the helmet until the reign of Richard I, when cylindrical helmets, flat at the top, were introduced, with an *aventaille*, or plate, to protect the face. After this, successive changes were made in the form of the *visor*, *beaver*, or *aventaille*, names applied at different periods to the front or movable part of the helmet, which was perforated with holes, to allow the wearer to see and breathe, and could be raised at pleasure to allow him to eat and drink, without removing his head-piece. When plate armour was worn, the face of the knight was entirely concealed by the helmet, which was constructed so as to cover the head and neck of the wearer; and this gave rise to the introduction of crests as a mark of distinction, by which he might be recognized. When the use of plate armour was partly abandoned, the iron breast and back pieces, and the pot or morion, a steel cap with a projecting rim, were retained for some time, being worn by the soldiers of the Commonwealth, and by troopers in the time of Charles II., and subsequent kings. In the present day, metal helmets are worn by the life-guards, horse-guards, and many dragoon regiments, and regiments of yeomanry cavalry; those of the household cavalry having a spike rising from the top, from which a plume of horsehair falls on all sides over the helmet.—*Ref.* Meyrick's *Critical Inquiry into Ancient Armour, &c.*; Meyrick's *Engraved Illustrations of Ancient Armour, from the Collection at Goodrich Court*; Grose's *Treatise*.

HELMET.—In Heraldry, the crest is always depicted on or above a helmet, the shape of which differs for different ranks. The sovereign and princes of the blood royal have a full-faced helmet of gold, with gold bars over the opening in front; dukes and marquises, the same, but of steel with steel bars; earls, viscounts, and barons, an open helmet of steel, in profile, with steel bars; baronets and knights, a full-faced steel helmet with the visor raised; and esquires and gentlemen, steel helmet in profile, with the visor closed.

HELVETII, *hel-ve'-she-i*, the name of a Celtic people who, according to Cæsar, occupied the country between the Jura on the west, the Rhone and Lake Leman on the south, and the Rhine on the east and north. Their country thus corresponded pretty closely with the limits of modern Helvetia or Switzerland. It was divided into four districts or *pagi*, and had twelve towns and 400 villages. Incited by one of their chiefs, Orgetorix, they determined to leave their country; burned their towns and villages; and taking with them provisions for three months, appointed a general rendezvous at Geneva, in the spring of B.C. 58. Cæsar, who was then at Rome, hurried off as quickly as possible to intercept them, and, arriving at Geneva, destroyed the bridge over the Rhone. The Helvetii sent to him soliciting a passage; but, demanding some time to consider of it, he employed the interval in raising a wall or rampart on the south side of the river. Having given a denial to their request, the Helvetii attempted to break through the wall; but in this they failed. They then took another route through the country of the Sequani and Ædui, followed by Cæsar. When within eighteen miles of Bibracte (Autun), he left the rear of the Helvetii and moved towards the town, in order to get supplies. On this, the Helvetii faced about and attacked him, and a general engagement was the result. The Helvetii fought with desperate valour, but they were at length defeated with great slaughter. Of 368,000 of the Helvetii who left their homes, of whom 92,000 were fighting men, only 110,000 returned to their own country, the rest being slain in battle, or afterwards massacred. Numerous Roman castles and colonies were planted in their land, which was known as the Ager Helvetiorum, until it was attached to transalpine Gaul. Having refused to acknowledge Vitellius as emperor, they suffered severely from his generals; and after that time they almost disappear as a people.—*Ref.* Smith's *Dictionary of Ancient Geography*.

HELWINGIACEÆ, *hel-win-ge-ai'-se-e*, in Bot., a nat. ord. of *Dicotyledones*, sub-class *Monochlamydeæ*. There is but one known species in this order, namely *Helwingia ruscifolia*, a shrubby plant found in Japan, where its leaves are employed as an esculent vegetable. The order is allied to *Garryaceæ*, from which it is distinguished by its alternate stipulate leaves, fascicled flowers, and 3—4-celled ovary.

HEMERALOPIA. (*See* NYCTALOPIA.)

HEMICARP. (*See* CREMOCARP.)

HEMIDESMUS, *hem-e-des'-mus* (Gr. *hemi*, half; *desmos*, a bond), a gen. of the nat. ord. *Asclepiadaceæ*. The root of *H. indicus*, or Indian sarsaparilla, is officinal in the Dublin Pharmacopœia. It has been for some time in use in India, under the name of country sarsaparilla, and was declared by the medical officers of the Madras establishment to be an efficient substitute for true sarsaparilla in the treatment of scrofulous, syphilitic, and cutaneous affections.

HEMIPTERA, *he-mip'-ter-ă* (Gr. *hemi*, half; *pteron*, wing), an order of haustellated insects having their wing-covers formed of a substance intermediate between the elytra of beetles and the other ordinary membranous wings common to most insects. When the *Hemiptera* quit the egg, they have the appearance of small hexapod larvæ, differing but little from the perfect insect, save in the absence of wings; and before these latter are acquired, the skin is shed several times, and the larva acquires a much larger bulk. The bed-bug (*Cimex lectularius*) and the water-boatman (*Notonecta*) are examples of the family of Hemiptera.—*Ref.* Baird's *Cyclopædia of the Natural Sciences*.

HEMISPHERE, *hem'-is-fere* (Gr. *hemi*, half, and *sphaira*, a sphere or globe), the solid obtained by dividing a sphere into two equal parts in the plane of any great circle passing through the poles, or in a plane passing through a diameter of the sphere in any part. In Astron. and Geol., the field of the heavens and the earth is divided into the northern and southern hemispheres, by a plane passing through the equator; and the latter is also divided into the eastern and western hemispheres, by a plane passing through the 30th meridian W. of Greenwich.

HEMLOCK. (*See* CONIUM.)

HEMORRHAGE. (*See* HÆMORRHAGE.)

HEMP. (*See* CANNABIS and LINEN MANUFACTURE.)

HENBANE. (*See* HYOSCYAMUS.)

HENNA. (*See* LAWSONIA.)

HENRY RIFLE, *hen'-re*, a fire-arm which takes its name from Mr. Alexander Henry, gunmaker, of Edinburgh, the inventor of the peculiar system on which the barrel is rifled. It is considered by many to be superior to any rifle that has yet been produced, and this seems to be borne out by the satisfactory shooting that has been made with this weapon by Mr. Edward Ross (the champion shot, 1860), Lord Vernon, and others, at the meetings of the National Rifle Association, at Wimbledon, and other gatherings of English and Scottish marksmen elsewhere. A horizontal or transverse section of the barrel shows the rifling to be heptagonal, with small ridges of metal, or "lands," projecting at each angle. The lands are made either acute in form, rectangular, or rounded. The interior of the barrel, consequently, presents a series of seven planes inclined to each other at an angle of nearly 128·58°, which wind along the interior of the barrel with a regular twist of one turn in 20 inches in a rifle with a gauge of ·451 inch; but the pitch varies according to the calibre of the arm, from 20 inches to 6 feet. The adoption of a projecting ridge at each angle of the rifling gives a double number of bearing-points to impart a rotatory motion to the bullet, and tends to diminish the windage, by leaving but little room for the expansion of the bullet when the piece is discharged, so that the missile leaves the barrel very slightly altered in shape. In consequence of this, the friction of the air on a bullet fired from a Henry rifle is far less than that which it exercises on a projectile discharged from any other description of rifled fire-arm, and there is less chance of the bullet "stripping," as it is termed, when the missile leaves the barrel without turning in the grooves or rifling. In some rifles made by Mr. Henry, the additional bearing-points are obtained by making a curved groove in the centre of each plane. This arm does not foul as quickly as other weapons that are loaded at the muzzle. The ball is cylindro-concoidal in form, and fits easily into the barrel. There is little recoil, and, as the bullet is not liable to strip, an increased charge of powder may be used, which gives a lower trajectory (*see* RIFLE, TRAJECTORY) and insures greater accuracy in the flight of the projectile. The Henry rifle is fitted with a patent wind-gauge sight, for regulating the aim according to the strength of the wind, and, if required, a patent elevating cheek-piece can be attached.

HENRY-MARTINI. (*See* MARTINI-HENRY RIFLE.)

HENSLOVIACEÆ, *hen-slo-ve-a'-se-e*, in Bot., a small nat. ord. of tropical *Dicotyledones* in the sub-class *Calycifloræ*. It contains but one genus, consisting of three or four species, which resemble in most respects the hydrangeas, the chief differences being in their tree-like habit, in the union of their styles into a cylinder, and in the total absence of albumen. Their properties and uses are unknown.

HENWARE. (*See* ALARIA.)

HEPATICACEÆ, *he-pat'-e-kai'-se-e* (from Gr. *hepar*, liver), in Bot., the Liverworts, a nat. ord. of flowerless plants, sub-class *Acrogenæ*,—small cellular plants, either with a creeping stem bearing minute imbricated leaves, or with a lobed leaf-like frond, or thalloid expansion. The reproductive organs are of two kinds, called respectively *antheridia* and *archegonia*, which may be either on the same plant or on different ones. The liverworts are generally diffused over the globe, but they are most abundant in damp, shady places in tropical countries. There are about 65 genera, which comprise upwards of 700 species. Their properties are unimportant. Some have been used medicinally in liver complaints. *Marchantia hemisphærica*, and other species, have been employed in the form of poultices in dropsy.

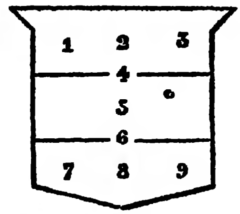
Hepatitis, *hep-ă-ti'-tis* (Gr. *hepar*, the liver), a term applied to inflammation of the liver. The history and symptoms of this disease have been particularly dwelt upon in all medicinal works from the earliest periods. Until very recent times, when the attention of physicians was more especially called to diseases of the gastro-intestinal mucous membrane,—heretofore a field comparatively unexplored,—this affection, and its subsidiary diseases, were more studied than any other lesion of the digestive apparatus. In temperate latitudes hepatitis is a rare disease; but in tropical climates it is often so acute, sudden, and fatal, as to defy medical treatment. The principal indications of the disease are, pain in the right side and shoulder, tenderness in the right hypochondrium when pressed, together with enlargement of the liver, often vomiting, always fever, with loss of appetite and a foul tongue. It is frequently accompanied by jaundice. Hepatitis sometimes terminates in abscesses, which, on some occasions, require to be opened externally. Professional assistance is necessary with regard to them, as the treatment is complicated. After the disease has been subdued, vegetable tonics are useful in restoring the digestive powers. When the disease has supervened in a warm climate, a removal to a more temperate region is always advisable.

Heptagon, *hep'-tă-gon* (Gr. *hepta*, seven, and *gonia*, angle), a term in Geom. applied to a plane figure composed of seven sides. The area of a regular heptagon is equal to the square of one of its sides multiplied by 3·633914 (or seven-fourths of the tangent of the angle at the base to radius 1). (*See* Geometry.)

Heptandrous, *hept-ăn'-drus*, in Bot., a term which signifies a plant having seven stamens.

Herald, *her'-ăld* (Low Lat. *heraldus*, Sax. *herault*).—Among the Greeks and Romans, heralds were employed to carry messages to friendly and hostile nations, to conclude treaties of peace and amity, or to declare war. (*See* Feciales.) In medieval times, their duties were very similar, and they had the direction and management of tournaments and jousts, and the regulation of ceremonies of state: it also fell to their part to make lists of the knights and soldiers who were slain in battle. The supervision of pedigrees of descent, and the armorial bearings of families, also came within the especial province of the heralds, who, with the kings-at-arms, held visitations in different counties at certain times for this purpose. Heralds are first mentioned under this title about the middle of the 12th century. The English heralds were formed into a body corporate by Richard III. (*See* Heralds' College.) When Great Britain declares war against any other power, the heralds make a formal proclamation of the same in the city of London.

Heraldry, *her'-ăld-re* (Nor., from Low Lat.), the science which teaches everything relating to armorial bearings, badges of honour, the order of precedence to be taken by all estates of the realm; the ceremonials to be observed at coronations, royal christenings, marriages, and funerals; the creation of peers, knights of the Garter, &c.; and on public occasions, such as the opening of parliament. Heraldry, as far as the distinction of families and tribes by various emblems is concerned, is a science of great antiquity. The twelve tribes of the Jews had each its cognizance, and the standards of nations from the earliest ages bore some particular heraldic device. (*See* Badge, Flag.) But the terms and distinctions of modern heraldry originated about the middle of the 12th century, when the use of armour, and the helmet with closed visor, which concealed the countenance, rendered the assumption of marks of distinction, such as the crest on the casque, and the armorial bearings on the surcoat, absolutely needful to enable the combatants to distinguish friend from foe in the heat of battle. Shortly after this period, armorial bearings, which had been assumed at pleasure by those who bore them, became hereditary, and confined to certain families. There are ten different kinds of armorial bearings; namely,—arms of Adoption, Alliance, Assumption, Community, Concession, Dominion, Patronage, Pretension and Succession, and arms Hereditary. The chief of these are arms of Dominion and Pretension, the first of which are borne by sovereigns in virtue of the territories over which they rule, and the second in virtue of countries over which they claim a right to rule, but exercise no actual authority; arms of Community, or armorial bearings borne by cities, bishoprics, and bodies corporate; arms of Alliance, which are used by families, to show the intermarriage of an ancestor with an heiress, and to indicate their maternal descent; and arms Hereditary, which descend from father to son, the fourth bearer of any coat from the first possessor, or his great grandson, being considered a gentleman of ancestry. To proceed briefly with what may be termed the grammar of heraldry:—If the field of the shield be divided into three equal portions by horizontal lines, the upper part is distinguished as the chief, the middle part as the fess, and the lower part as the base. There are also nine points used to indicate the situation of charges: these are —1. dexter chief; 2. middle chief; 3. sinister chief; 4. honour point; 5. fess point; 6. nombril point; 7. dexter base; 8. middle base; 9. sinister base.



The colours and metals used in blasonry are nine in number, the metals being or and argent; the colours, gules, azure, sable, vert, purpure, tenne, and sanguine. These are all indicated, in engraving, by various lines and dots, after the method said to be invented by Petrasancta, an Italian; they are severally noticed under their respective headings. Certain furs are also used, which consist of ten distinct sorts or varieties. (*See* Ermine, Potent, Vair.) There are also nine principal ordinaries, or charges, termed "honourable," and fourteen subordinate ordinaries. The principal ordinaries are the chief, pale, bend, bend sinister, fess, bar, chevron, cross, and saltier. The fess occupies the third and central part of the shield, as shown above, and is considered to be derived from the broad baldric, or belt, that encircled the loins of the warrior. The cross, when considered as an ordinary, consists of two broad stripes or bars, one perpendicular and the other horizontal, crossing each other at right angles, in the centre of the shield. There are, however, numerous forms of the cross used in heraldry; such as the cross avellane, cross bottonny, and cross crosslet, which are classed among common charges. The remaining principal ordinaries, with their diminutives, are mentioned under their respective headings, as are also the lines of division or demarcation, used as outlines of the ordinaries, or to divide the field of the shield in directions indicated by the names of all these charges, except the chief; as, "party (or parted) per bend," when the shield is divided by a diagonal line, proceeding from the dexter chief to the sinister base. These lines of partition are termed Embattled, Engrailed, Dancette, Indented, Invected, Nebuly, Raguly, and Wavy. The subordinate ordinaries, are the canton, a third part of the chief on the dexter side; the gyron, a gusset-shaped ordinary, occupying the eighth part of the shield, and formed by a right line and diagonal line meeting in the centre of the shield, or fess point; the fret, formed of two diagonal bars, and a lozenge-shaped frame in the centre of the shield, interlaced; the quarter (*see* Quarter); the pile (*see* Pile); the orle and tressure (*see* Orle); the flanches, flasques, and voiders (*see* Voiders); and the lozenge, fusil, mascle, and rustre (*see* Lozenge). To these charges, innumerable representations of the various heavenly bodies, the human form, and its different parts, the head, hands, &c., birds, beasts, fishes, flowers, trees, boughs, towers, weapons, and implements, or parts of implements, of various kinds, which are blazoned according to the position in which they are depicted, and their situation in the shield, or with regard to other ordinaries and charges that appear in it. Armorial bearings, in an extended sense, consist of four parts: the shield, and its charges; the crest, which is generally drawn surmounting a helmet (*see* Crest, Helmet), which is surrounded by pieces of silk or velvet, jagged at the edges, and lined with fur,

which are termed "mantlings," or "lambrequins;" the motto, which may be assumed at pleasure (*see* MOTTO); and the supporters, which are not borne by commoners (*see* SUPPORTERS). For further information respecting matters intimately connected with the science of heraldry, the reader is referred to the following articles, which bear directly upon them. (*See* BLAZONRY, DIFFERENCES, MARSHALLING OF ARMS.)—*Ref. Glossary of Heraldry*, Parker, Oxford; Burl's *Armorie of England*; Guillim's *Display of Herald*; Ferne's *Blazon of Gentrie*; Clarke's *Manual of Heraldry*.

HERALDS' COLLEGE, a corporation consisting of the three English kings-at-arms, six heralds, and four pursuivants, to whom a charter of privileges was granted by Richard III., in 1483. This king also gave them a house, in which they might hold their chapters and deposit their records; but it was taken from them shortly after by his successor, Henry VII. Edward VI., however, confirmed their charter, and Queen Mary gave them a building on Benet's Hill, St. Paul's Churchyard, known as Derby House, on the site of which the present college now stands. The kings-at-arms are Garter, Clarencenx, and Norroy; the heralds, Somerset, Chester, Windsor, Richmond, Lancaster, and York; the pursuivants, Blue Mantle, Rouge Croix, Rouge Dragon, and Portcullis. There is a king-at-arms attached to the order of the Bath, named Bath king-at-arms, who has no connection with the heralds' college. Pedigrees are preserved, and grants of arms are made and registered by the members of the college, who are privileged to receive certain fees, in virtue of their office, from those who wish to search their records or avail themselves of their services in any way. In Scotland, there is a college of arms, consisting of Lyon king-at-arms, six heralds, and four pursuivants; and in Ireland, the chief heraldic officer is termed Ulster king-at-arms.

HERBARIUM, *her-bair'-e-um*, a term generally applied to a collection of specimens of plants carefully dried and preserved. Such collections are very valuable,—for a well-preserved plant displays its botanical structure, in all its minutiæ, better than the most accurate engraving. In order to compose an herbarium, plants are usually collected in a tin box, called a "vasculum," which preserves them from withering for at least a short time. They should be gathered on a dry day, and those which have collected moisture in their leaves should be placed in a vessel of water and be allowed to dry there. It is necessary to kill plants with succulent stems or leaves, by immersing them for a short time in hot water. In order to complete the drying of the specimens, they are placed between layers of bibulous paper, so as not to distort their parts. Pressure is then applied, which varies according to the nature of the plants. Great care is necessary in order to avoid using too much pressure at first. The paper is changed every day, or every second day, and dry paper supplied for a short time. Those specimens which are quickly dried have the best appearance; and some plants which lose their natural colour and turn black in the ordinary mode of drying, can be beautifully preserved by a quick process. Thus, in the case of the orchids, and other similar plants, when placed between layers of paper, inclosed in a wire net-work frame, and hung before a fire, where the package is made to turn like meat roasting, they can be exquisitely dried in a few hours. By the ordinary process they would require eight or ten days. When properly dried, the specimens are placed in sheets of writing-paper, and may be slightly fastened by making the top and bottom of the stalk pass through slits in the paper for the purpose. The name of the genus and species, the locality where it was found, together with any other interesting information, are then marked beside each. The method of preserving cryptogamous plants is more difficult, on account of the greater quantity of moisture which they contain, and the great delicacy of their texture. Herbaria are generally ranged on a h[illegible] and great care is [illegible]ired in order to preserve their contents from the ravages of moths and beetles. Camphor and a little corrosive sublimate are good preservatives. There are some herbaria in existence which have lasted for centuries, and which are still consulted for the identification of species. Those collected by travellers in distant countries are frequently of great [illegible]

HERBS, *herbs* (Lat. *herba*), in Bot., plants which have stems that die down annually to the surface of the ground. The term *caulis* is used to distinguish an herbaceous stem.

HERCULES, *her'-ku-lees*, a constellation in the northern hemisphere, formed by the old astronomer Aratus, but considered to have received its present name from some later astronomer. It is surrounded by the constellations Boötes, Draco, Lyra, and Ophiuchus. It contains no stars of the first and second magnitude.

HEREDITARY PRIVILEGES AND POSSESSIONS, *he-red'-e-ta-re* (Fr. *héréditaire*, fr. the Lat.).—In the government and social constitution of many countries, hereditary rights and privileges are allowed to certain individuals or families; and the question of the admissibility of these rights and privileges has frequently been agitated, especially in recent times. Hereditary monarchy has its supporters and its opponents. The "divine right" of kings is seldom urged now as an argument in its favour; and the advisability of hereditary transmission of the chief power in the state is at present principally rested on the ground of political necessity and expediency. It must also be allowed that the excitement and political animosities which the recurring election of a general governor would call forth are avoided by having hereditary power in a particular family. In this country, moreover, the dangers and evils which might arise through a governing power being dependent upon birth, are neutralized by the national institutions, even if honour and high position were not able to prove a restraint. Besides hereditary monarchy, however, in this country, there is the question of hereditary classes, dignities, and offices in the state. The hereditary transmission of posts in the state, the powers attached to which are almost monarchical, is inconsistent with the idea of a free state. An hereditary nobility, with rights similar to those of the petty princes of Germany, cannot be looked upon as an advantageous state of affairs. But the existence of a class with certain hereditary privileges, as in this country, may be of great advantage to a nation. Those families whose hereditary traditions form a portion of the national history naturally identify themselves with the prosperity and honour of the country. When such a class can command an excellent education, and possess well-assured property, together with a high sense of honour, they are raised above all pettiness and meanness, and are valuable examples in a country like our own. The hereditary privileges of the nobility, however, can be abused; and the great revolution of France was an example of the fearful results of such an abuse of power.

HERESY, *her'-e-se* (Gr. *hairesis*, choice, election), may be defined as the act of holding opinions upon religious matters contrary to the authority and teaching of any religious community to which a person may be presumed to owe obedience. Primitively, however, it was used to designate any opinion that a man or a sect might choose to adopt; and in this way it was applied to the philosophic sects of the Greeks and Romans. In the New Testament, even, the term is frequently used to designate a religious sect, without any reproach being implied. In this sense it is used in Acts v. 17; xv. 5; xxviii. 22; and Josephus terms the three great Jewish sects, heresies, without wishing to imply any censure. On the other hand, it was used in a reproachful sense by the Apostles towards those who denied their doctrines, and by the Jews towards Christianity. In the writings of the Christian fathers we find the term employed towards those opinions which differed from what was deemed to be the doctrine of the Apostles; and later, when Christian teaching came to be regulated by ecclesiastical councils, any one who rejected their decisions was proclaimed to be a heretic; whilst those who gave their adherence to what was settled by these councils were proclaimed to be orthodox, or catholic. It is necessary that heresy should not be confounded with schism, or with apostasy; the latter implying a complete renunciation of Christian doctrine, whilst schism means only the rejection of some point of discipline, just as heresy

denotes any division upon matters of doctrine. The early fathers gave the number of heresies as ranging between eighty and a hundred and fifty, although Lardner, in his "History of Heretics," demonstrates that these figures are somewhat exaggerated. Nearly all the heretical opinions current in the first two centuries of the Christian era appertain to the creation of the world, to the connection between Christianity and Judaism, and to the person of our Saviour. The two great sects were the Ebionites and the Gnostics. (*See* these words.) In the 3rd century the Manichæan heresy took birth. At the head of this sect was Manes, whose object it was to engraft upon the teachings of the Apostles the rites taught by the Persian magi. Passing over the heretical controversies of Sabellius, of Novatian, and of Paul of Samosata, all of which arose during the 3rd century, we reach the great Arian heresy, which formed the chief object of theological discussion during the 4th century. The only new sects which require distinct mention are the Pelagian, which sprang forth in the 5th century; the Nestorians, and their adversaries the Eutychians; the Monothelites, the Monosophytes, and the Paulicians. Previous to the Reformation in England, heresy was enacted, by 2 Henry IV. c. 15, to be the holding of opinions contrary to the Catholic faith and the determination of Holy Church; and the offender might be convicted of heresy at common law by an archbishop in a provincial synod. After conviction, the criminal was to be dealt with according to the king's pleasure. When a person, after having abjured his heresy, again relapsed into it, the king in council might issue the writ *de hæretico comburendo*, upon which the criminal was handed over to the secular authority to be openly burnt alive. The first statute of the reign of Elizabeth repealed all previous enactments, leaving it at common law, although it did not determine what heresy actually is, merely limiting it to "such as heretofore hath been adjudged heresy," according to the scriptural authority and that of the four councils. Both Elizabeth and James I. are stated to have burnt heretics; and Lord Coke (3 Instit. c. 5) approved of burning heretics alive. The writ *de hæretico comburendo* was abolished by 29 Charles II. c. 9, and henceforth the punishment of heretics was vested in the ecclesiastical courts, who might punish heresy *pro salute animæ*, from a pure regard for the offender's soul. Thus stands the law at the present time, when it is a matter of the utmost difficulty to define either what heresy actually is, or what is the punishment for it. It is true that heresy is left completely to the jurisdiction of the ecclesiastical courts; but as the power of these tribunals has been much limited by the many toleration acts, no less than by the almost indefinite construction that may be placed upon the doctrinal forms of the Anglican church, the practical effect is found to be an almost complete toleration of doctrines opposed to the Articles of the Establishment. A glorious and instructive change is this from the practice of burning alive any one who dared to express a free opinion upon matters of religion. The reader is referred to the proceedings instituted against Dr. Rowland Williams, and to the judgment of the Court of Arches.—*Ref.* Mosheim's *Ecclesiastical History*, vol. ii.; Stockmann's *Lexicon Hæresium*; Walch's *Geschicte der Ketzereien*.

HERIOT, *her'-e-ot* (Sax. *heregeate*, literally war-treasure), is a feudal service due to the lord of the manor, upon the death, and sometimes upon the alienation, of a tenant. It consists in rendering to the lord the best jewel, beast, or chattel that was owned by the deceased. This fine was enforced in England prior even to the Norman conquest, and although at this latter period an analogous service, under the name of Reliefs, was introduced, the heriot was not abolished. The chattels which were first given in this way appear to have been the horse and armour of the deceased lease- or copy-holder. At first voluntary, it came in course of time to be compulsory. There are two kinds of heriots; heriot-service and heriot-custom, for the former of which the lord of the manor may either seize or distrain, while for the latter he cannot, although he has the right of choosing the best beast or chattel. Formerly the right of heriot-custom was freely exercised in the case of freehold lands; but at the present time it is almost exclusively confined to lands held by customary tenure, whether these latter be copyholders, conventionary estates under the duke of Cornwall, customary freeholds of the northern border counties, or lands in ancient demesne. In Scotland other similarly vexatious fines are levied upon land.

HERMAPHRODITE FLOWERS, *her-maf'-fro-dite* (Gr. *hermaphroditos*), in Bot., are those which possess both stamens and pistil.

HERMENEUTICS, *her-men-u'-tiks* (Gr. *hermeneutes*, an interpreter), is the science of interpreting or discovering the true meaning of the holy Scriptures. Although often confounded with exegesis, it bears a very marked distinction from that branch of study. (*See* EXEGESIS.)

HERMETIC BOOKS, *her-met'-ik* (Fr. *hermétique*), a term applied to the supposed literary compositions of the ancient Egyptian god Thoth, who was believed to have acted as the scribe of the other gods. Tradition varied as to the character and number of these inspired writings, which were held to contain all knowledge, whether divine or human, in its totality. Clement of Alexandria gives the number of the hermetic books as forty-two; Iamblichus, as 20,000; while Manetho raises the number to 36,525. According to the best authorities, these writings were:—one book containing the sacred hymns of Osiris; one book on the life of a king; four books of astrological precepts and observations; eleven books treating of the cosmography, geography, and chorography of Egypt and the Nile; ten upon the laws and discipline of the priesthood, and six treating of medicine. Several pretended Greek translations of these books have survived; but the true origin of these writings is held to be due to Egyptian, Persian, and Rabbinical sources. In mediæval times, the alchemists and astrologers were particularly prone to entitle their works hermetic writings.

HERMIT, *her'-mit* (Gr. *heremitis*, an inhabitant of a desert), a term often applied in the early, but more frequently in the later church, to a person who, in order to resist the temptations and cares of the world, withdrew himself from society to a cavern, a mountain, a desert, or other solitary situation, there to devote himself to prayer, fasting, and mortification of the flesh. (*See* ANCHORITE, ASCETICISM.)

HERMIT CRAB. (*See* CRAB.)

HERNIA, *her'-ne-å* (Gr. *hernos*, a branch, from its protruding forwards), a general term in morbid Anat., applied to the protrusion of any viscus from its natural cavity. In a more restricted sense, however, the word only signifies a protrusion of the abdominal viscera. Hernia, in the latter form, is unfortunately very frequent. Many causes contribute to this frequency. There are three natural openings which are weak and unprotected in the walls of the abdomen. These openings yield easily, and permit the escape of any viscus that may be pressed towards them with even a moderate degree of force. The nature of the walls, too, which are principally composed of muscle, and the condition of the viscera within,—loose, liable to change of size and situation, and subject to irregular pressure by the contractions of these muscular walls,—all unite to render these weak situations still more weak. The places referred to are called the umbilicus, and the inguinal and femoral canals. There are, however, other situations where hernia may occur, though such cases are unfrequent. It is also evident that if the muscles or tendons of the diaphragm are wounded, some portion of the contents of the abdomen may escape; thus constituting the varieties of ventral and phrenic hernia. The forms of this disease have consequently been arranged and named according to the places where they occur. Besides this division as to situation, there is another, of great importance, derived from the nature of the viscus displaced. Men are much more liable to hernia than women, the proportion being about four to one; and the liability to the disease increases with years. A hernia is always composed of a "sac" and its contents. The former is a portion of the peritoneum pushed forward by the protruding viscera, and forming a pouch. The contents of the sac vary greatly; but generally consist of a portion of the small intestine, especially the *ileum*. A certain quantity of fluid is always found secreted in the sac together with the viscera. The principal divisions of the ordinary disease are,—reducible (when

it is returnable into the abdomen), irreducible, and strangulated hernia. Reducible hernia is treated either with a truss, so as to retain the protrusion within the cavity of the abdomen, or the treatment may be radical, the contrivances for which are purely surgical. In the former case, each particular kind of hernia requires its special form of truss; and before applyin it, the hernia must be reduced by placing the patie on his back, relaxing the muscles by bending back the thigh, and pressing the tumour back in the proper direction. The protruded viscus cannot be returned into the abdomen in irreducible hernia. Cases of this kind are treated either by means of a truss having a hollow pad, so as to embrace the tumour, or radically, in some cases, by keeping the patient recumbent, on low diet, for two or three months; during which time the bowels are kept open by laxatives and injections, the tumour being equally pressed during the time. When a portion of the intestine protruded is so tightly constricted that it not only cannot be returned into the abdomen, but has its circulation arrested also, the disease is called strangulated hernia. If relief is not speedily obtained when the disease occurs in this form, it is highly dangerous; for the strangulated part becomes gangrenous. If the intestines cannot be returned by pressure, chloroform is administered internally, so as to relax the muscle, or a hot bath, or bleeding to the verge of faintness. If none of these methods are of any avail, the operator is obliged to divide the constriction by means of the knife.

HERO, HEROIC AGE, *he'-ro, he-ro'-ik* (Gr. *heros*, a being intermediate between gods and men).—During the Homeric period, any king, prince, leader in battle, or one who distinguished himself above his companions as a brave warrior, or in wisdom, or in beauty, was fabled to be of divine origin, and after death was worshipped as a deity by those cities or races of mankind that claimed him as founder or ancestor. Thus Perseus, Theseus, and other warriors of mythological history, were called heroes. The greatness and glory of these heroes were held up to the example and admiration of the whole Greek peoples. According to Thirlwall, the heroic age lasted during six generations, or about two hundred years, terminating with the death of the near descendants of those Greeks who fought at Troy. In Homer, however, the word hero is often synonymous with warrior, or even with wise man or king.

HEROIC VERSE, that in which epic poetry, devoted to a history of the exploits of heroes, is composed. In Greek and Latin, *heroic verse* is generally expressed in hexameter lines; in English, Italian, and German, by the iambic of ten syllables, either with or without the additional short syllable; and in French, by the iambic of twelve syllables. (*See* also articles EPIC and HEXAMETER.)

HERON, *her'-on* (Fr.; Lat. *ardea*), belongs to the class *Grallatores*, a fam. of birds of which the common heron (*Ardea cinerea*) is the general type. The characteristics of the *Ardeidæ* are as follows:—Beak long, strong, straight, compressed in a lengthened cone; upper mandible slightly channelled, ridge rounded; nostrils lateral, basal, pierced longitudinally in the groove, and half-closed by a membrane; legs long, slender, naked above the tarsal joint; three toes in front, the two outer united by a membrane, one toe behind directed inwards; claws long, compressed, sharp, the middle claw denticulated on the inside; wings of moderate length, the first quill-feather a little shorter than the second or third, both of which are the longest in the wing. The common heron is one of the most numerous, as well as the best known of wading birds, and formerly the bird was considered royal game, and statutes were passed for its preservation. The heron is said to be very long-lived, and was formerly held in considerable estimation as an article of food. It visits most parts of the United Kingdom, and occupies the heronries, which are built for its comfort, from spring until the month of August. It visits Scandinavia in summer, going occasionally as far north as the Faroe islands, Iceland, and the southern coast of Greenland; but it is most abundant in Holland. The plumage is usually of a bluish-ashy colour, and the average length of the bird from the point of the beak to the end of the tail about three feet, while from the carpal joint to the end of the wing, the extent is about seventeen inches. The solitary habits of the heron are well known, for, except during the breeding season, when they congregate in large flocks, they are generally seen alone. Their food is nearly entirely composed of fish, and they will be seen standing for hours by the side of ponds and streamlets, watching for their prey, which they catch by a single dart of their powerful beak. Besides the common heron, there are the *purple heron*, which is found in the temperate parts of Europe, in Africa, and in Asia; the *great white heron*, an accidental visitor to this country, but common in the eastern parts of the Mediterranean; the *buff-backed heron*, and the *squacco heron*, a native of Egypt.—For further information on these latter varieties, the reader is referred to Yarrell's *History of British Birds*, which treats at length on the subject.

HERO'S FOUNTAIN. (*See* HYDRAULICS.)

HERPETOLOGY, *her-pe-tol'-o-je* (Gr. *herpeton*, a reptile; *logos*, a discourse), a term applied to that portion of Nat. Hist. which treats of reptiles. This branch of science has received the attention of naturalists both in ancient and modern times. Linnæus gave much study to the subject, and Ray devoted considerable time to it. Lacépède, Brongniart, Latreille, and Dandin also contributed to its advancement in the end of the 18th and beginning of the 19th century. In later times the principal writers on herpetology have been Sklegel, Gray, Müller, Owen, and others. Additional interest is added to the study of this branch of science on account of the numerous fossil remains of reptiles belonging to former geological periods which have been found. Many of these possess extraordinary characters, and are of immense size. Until lately, the Batrachia, or Amphibia, have always been included with the reptiles; consequently, in most works on herpetology a description of them is to be found.—*Ref.* Bell's *History of British Reptiles*, which contains a full account of all the British species, including the Amphibia.

HERRING, *her'-ring* (Ger. *heer*, an army, on account of the great numbers in which they visit our shores), belongs to the family of the *Clupeidæ*, a branch of the order termed *Malacopterygii*, on account of their being possessed of a scaly body like the salmons, no adipose dorsal fin, and by the upper jaw being formed in the middle by the intermaxillary, and on the sides by the maxillary bones. The length of the head, compared to the length of the body alone, without the head or caudal rays, is as 1 to 4; the depth of the body compared to the whole length of the fish, as 1 to 5; the commencement of the dorsal fin is halfway between the point of the upper jaw and the end of the fleshy portion of the tail; the longest ray is nearly as long as the base of the fin; the pectoral fin being rather large compared to the size of the other fins. The ventral fin arises considerably behind the line of commencement of the dorsal fin, and is small, with elongated axillary scales, its origin halfway between the point of the lower jaw and the end of the short central caudal rays. The anal fin begins halfway between the origin of the ventral and the end of the fleshy portion of the tail, and extends over half the distance between its origin and the end of the fleshy portion; thus occupying the third quarter division of the distance between the origin of the ventral fin and the end of the fleshy portion of the tail. The rays are very short; the tail considerably forked, with the outer rays double the length of the middle ones. The lower jaw is much the longest; the dorsal and abdominal lines of the body slightly convex; the belly carinated, but not serrated; the scales moderate in size, oval, and thin. The upper part of the fish is a fine blue colour, with green and other reflections, when viewed in different lights; the lower part of the side and belly, and the gill-covers, silvery white, exhibiting the appearance of extrava-

HERRING.

sation when the fish has been dead some twenty-four hours. The dorsal and caudal fins are of a dusky hue, and those on the lower parts of the body almost white. Such are the characteristics of the *herring*, according to Yarrell, who, in his account of British fishes, enters at large upon the subject. An account of the herring fishery, and their annual migration to the shores of Britain, is given under the article FISHERIES (which *see*); the herring being a constant visitor to our shores, where it continues some months. —*Ref.* Yarrell's *History of British Fishes*; Baird's *Cyclopædia of the Natural Sciences.*

HERRING FISHERY. (*See* FISHERIES.)

HESPERIDIUM, *hes-pe-rid'-e-um*, in Bot., a kind of fruit, examples of which are afforded by the orange, lemon, lime, and shaddock. It may be described as a superior, many-celled, few-seeded indehiscent fruit, having a separable rind formed of the epicarp and mesocarp combined together, and an endocarp projecting internally in the form of membranous partitions which divide the pulp into a number of portions or cells, which are easily separated from each other. This pulp is a development of succulent parenchyma, either from the inner lining of the ovary generally, or from the placentas only. The seeds are imbedded in the pulp, and attached to the inner angle of each of the divisions into which the fruit is divided. By some botanists the orange is considered as a berry with a leathery rind; but the berry is essentially different in its origin, as it is an inferior fruit.

HETEROLOGOUS SERIES, *het-er-ol'-o-gus* (Gr. *heteros*, various), in Chem., heterologous series are those whose members manifest a similarity of origin from homologues, but which differ considerably in their properties. (*See* HOMOLOGOUS SERIES.)

HEXAGON. (*See* CUBE.)

HEXAMETER, *heks-am'-e-ter* (Gr. *hex*, and *metron*, measure), the commonest and most important form of dactylic verse used amongst the ancient Greeks and Romans. It was termed *hexameter* in consequence of its consisting of six feet, either dactyls or spondees, which could be used indifferently throughout the verse, with two exceptions;—that the last foot must be invariably a spondee, and the last but one a dactyl. In a few rare cases, either to vary the rhythm or to produce some special effect, a spondee is introduced in the fifth foot, when the line is denominated a *spondaic* line. In modern times, several writers have endeavoured to introduce hexameter verse, with but little effect, as nearly all attempts have been utter failures, the specimens given being but of so many degrees of inferiority. Schiller hit on one of the best examples in his way, and Coleridge very excellently translated it in the same metre, carrying out fully the original author's idea.

"Schwindelnd trägt er dich fort auf rastlos strömenden Wogen;
Hinter dir siehst du, du siehst vor dir nur Himmel und Meer."

Which Coleridge translated:—

"Strongly it bears us along, in swelling and limitless billows;
Nothing before and nothing behind but the sky and the ocean."

However, the hexameters of Goethe and Schiller, although they contain much that is grand and beautiful, serve only for beacons, as is aptly said in the *Encyclopædia Britannica*, to "warn less skilful pilots off a coast where shipwreck is certain."

composition. It is the sixth of the series of the hydrocarbon radicles of the alcohols, and is also called caproyl.

HIATUS, *hi-ai'-tus* (Lat., a yawn, gap, or chasm), in Diplomatics and Bibliography, means a deficiency in the text of an author, from a passage erased. In Gram. and Prosody, it signifies the occurrence of a final vowel, followed immediately by the initial vowel of another word without the suppression of either by even an apostrophe. In the French language, the hiatus is most carefully avoided, but in England not so much attention is paid to it, although it is considered a blemish by the more careful writers.

HIBISCUS, *hi-bis'-kus* (Gr. *hubris*, haughtiness), in Bot., a gen. of the nat. ord. *Malvaceæ*. The species *H. cannabinus* yields the fibre known as *sunnee*, or *brown Indian hemp*, which is used in India as a substitute for true hemp. It is sometimes confounded with sunn hemp, which is the produce of a leguminous plant. (*See* CROTALARIA.) *H. arboreus*, a native of the West Indies, is also remarkable for the tenacity of its inner bark, and some authors declare that the whips formerly used by the slave-drivers were manufactured from its fibres. The petals of a Chinese species, *H. rosa-sinensis*, are astringent, and are used by the celestials to blacken their eyebrows and the leather of their shoes. Various other species of *Hibiscus* yield valuable fibres useful for textile fabrics, or for paper.

HICKORY. (*See* CARYA.)

HIDALGO, *hi-dăl'-go*, a distinction applied to a Spanish gentleman of the lower class of nobility, and derived from the words *hijo de alguna*, which mean, literally, "the son of somebody." The title, although frequently applied during the last century and middle ages, is now extinct.

HIDE, *hide* (Ang.-Sax.), an old English measure of land frequently mentioned in Domesday Book and other old chronicles. Its contents are almost uncertain, but are stated to have been 100 Norman, or 120 English acres.

HIERARCHY, *hi-e-rar'-ke* (Gr. *hieros*, sacred, and *archon*, government), literally means a *holy government*, and is used to signify either the constitution and government of the Christian church, or ecclesiastical polity, comprehending different orders of clergymen, and the government of the Church over the State. Taken in the former sense, with reference to the internal government of the Church, the *hierarchy* arose with the formation of the Christians on an independent establishment; for, although *presbyters*, or elders, were placed at the head of the earliest congregations of Christians, yet their constitution was essentially democratic, each and all of the members having a share in the concerns of the whole society, and a vote in the election of elders, the exclusion of renegades, and the reception of proselytes. Afterwards, the government of the Church became more and more transferred into the hands of the elders; and in the 2nd century, the bishops became chiefs, and took all authority in their own hands, although the elders were still possessed of some semblance of power. In the capitals of different provinces, the bishops were termed "Metropolitans," and were superior in office to the provincial bishops, and thus gradually an aristocratical hierarchy was formed, and the "metropolitans" of Constantinople, Antioch, Alexandria, and Jerusalem, were called "Patriarchs," and looked up to as the heads of the Church. In Greece, this constitution continued to prevail, but in Rome, it was transformed into a monarchy, and the Pope was established as the primate of the church of Western Christendom. In the second sense in which the word *hierarchy* is used, it refers to the relations of the Church and the State to each other; in which the former claims the superiority, and demands the subjugation of political influences to its own power. When the Christian church was first established, it did not seek or claim any influence whatever over the State, and the State considered itself bound often to persecute, and endeavour to destroy the Church; but when the Church was amalgamated with the State, in the time of Constantine the Great, it was protected by the State, which claimed for itself the privilege of interfering in the internal government of the same. Charlemagne, and others of the German emperors, claimed this sovereignty as a right, and after the feudal system arose, the bishops held the church lands as fiefs, from their temporal rulers. The *hierarchy* did not fully constitute itself until the Roman bishop, or Pope, was looked up to really as the head of the Church; and from that period the power of the Church over the State became gradually increasing. Of all the popes, Gregory VII. was the most energetic in spreading this power; and if he did not fully succeed in his object, his successors had a plain path marked out for them, which they followed to the letter. By the exertions of these latter members of the hierarchy, the

institution of the Church was elevated above the State, and its head ranked higher than any temporal ruler, as his power was supposed literally to emanate from the Deity himself. Papacy and the hierarchy began gradually to decline from the 14th century, as it had risen, and the disputes between Philip the Fair and the Roman pontiff, and the removal of the popes to Avignon, are instances of this decline in the spiritual supremacy of the Roman Catholic church. At the council of Basle, in 1431, the authority of the State was again proved superior to the Church, and the doubts and discussions stated by Huss and Wycliffe undermined considerably the power of the hierarchy. The Reformation was its last assailant, and by the Reformation, this institution was vanquished. The spiritual power of the pope became subjugated to civil law, and the State was elevated to a position from which it governed the churches. Thus the hierarchy received its death-blow; and the events which took place in Rome in 1861-62 tend to prove that the supremacy it once enjoyed is now and for ever annihilated. According to Dionysius the Areopagite, *hierarchy* also denotes a division of the angels, which were divided into three of these separate constitutions. The first hierarchy was composed of the cherubim, seraphim, and thrones; the second of dominions, virtues, and powers; and the third of principalities, angels, and archangels. In the commencement of Milton's "Paradise Lost," this subdivision of the angelic host is alluded to in the lines—

> "Thrones, dominations, princedoms, virtues, powers,
> Hear my decree."

Some of the Rabbins reckon four, and others ten hierarchies, or orders of angels.

HIEROGLYPHICS, *hi-e-ro-glif'-iks* (Gr. *hieros*, sacred, *glupho*, I engrave), a term generally applied to the representations of animals or other forms, used to express language, and more especially to those found sculptured on the monuments of Egypt. The ancient Egyptians appear to have used about 1,000 symbols, by means of which they were enabled to express themselves correctly and clearly. Amongst the ancient Greeks this mode of writing was called hieroglyphic, or hierographic; and its invention was attributed to Thoth, the Egyptian Hermes. In nearly all cases, hieroglyphics consist of representations of the sun, moon, and stars; the human form, animals, fishes; works of art, &c., which were either engraved in relief, sunk below the surface, or traced with a reed pen on slabs of stone, pieces of wood, or leaves of the papyrus. In the Egyptian monuments the hieroglyphics are sometimes plain, and sometimes decorated with colours. Those found on coffins appear to have been traced out and afterwards coloured; those inscribed on papyri are merely sketched out, and are called linear hieroglyphs. They are arranged in perpendicular or horizontal columns, separated by lines, and in some cases distributed in a sporadic manner in the area of the picture to which they refer. Hieroglyphics appear on the walls of the earliest tombs, and are even found scrawled on the blocks of stone which form the great pyramid of King Cheops. They continued in use for upwards of 3,000 years, when they were superseded by a more condensed writing, called the Demotic, and lastly by the modern Coptic, on the introduction of Christianity. All knowledge of the mode of deciphering heiroglyphics was lost from the 10th to the 16th century; and on the revival of learning, the task was undertaken in vain, till the discovery of the Rosetta stone in 1799, when a clue to their interpretation was gained. In 1814, Young was the first to discover, from the name of Ptolemy on this stone, and that of Berenice on a doorway in the south corner of Karnac, that certain hieroglyphics were used to represent sounds, and not ideas exclusively, as had been believed up to that time. The study of hieroglyphics has been pursued by many learned men, both in this country and on the continent, from that period. Hieroglyphs are divided into two classes,—ideographs, or symbols representing ideas, not sounds; and phonetics, which spell the sound of the word, the sense of which they are intended to convey. Nearly all the inscriptions are principally composed of phonetics, which are easily distinguished by their constant recurrence. The ideographs are divided into two classes,—first, those which represent the object directly; as a wolf to represent that animal, a man having the head of an ibis to represent the god Thoth, a bundle of flax to represent flax, &c.; secondly, those which are enigmatic, and express the idea by less direct means; as a woman beating a tambourine to express joy, a smoking pail for milk, an ape for anger or irritability, and a jackal for cunning. The number of these particular signs, however, was not many, as a certain class of them was used to express more ideas than one. Thus a figure representing a seated man signified man in all his relations, functions, and offices; meaning either father, brother, governor, priest, &c.; the particular meaning being conveyed by the arrangement of phonetics before the sign. In the same manner all acts of locomotion were represented by two legs in the act of walking; all actions where the arms were required, by an arm holding a stick; all precious stones by a ring; and all beasts and objects made of leather by a skin. These hieroglyphics closely resemble in their use the cuneiform characters of the Assyrians. (*See* CUNEIFORM.) The Chinese mode of writing is also very similar to the hieroglyphs of ancient Egypt in the use of the phonetics. The ideographs are often preceded by a group of phonetics, indicating the spelling. Thus *Ansh*, a wolf, is preceded by a hare A, a line of water N, and a basin SH; a jackal, *Sab*, "crafty," is preceded by the back of a chair S, and a chisel B. Those hieroglyphics called phonetics are fewer in number than the ideographs, and are divided into two classes,—those ending in vowels and those ending in consonants. The former are fifty-two in number; and as they represent eighteen sounds of the spoken language, answer the purposes of a pure alphabet. The grammatical forms, the abstract prefixes and affixes, substantive and auxiliary verbs,—in fact, the great body of the language, is composed of the phonetics. The groups of phonetics preceding the ideographs are constantly interchanged among themselves; and during the long period of three thousand years similar texts in the papyri show hundreds of words written with different symbols. The hieroglyphical inscriptions on stone among the Egyptians are all religious, historical, or sepulchral. All their books, with the exception of the Rituals, or hieratic books, were written in a cursive or flowing hand, of a very distinct, clear shape, with headings at the tops of the pages. This hieratic character, as it is called, did not employ so many symbols as the hieroglyphic, and approached nearer to the alphabetic system. It continued in use till the 2nd or 3rd century after the birth of Christ. After the 8th century B.C., it was only used for religious purposes. The demotic character was at first only an abridgement of the hieratic forms; but it rapidly lost all resemblance, and finally tried to accommodate the written language as nearly as possible to the alphabetical Greek and Phœnician systems then known to the Egyptians. It remained in use till the 3rd century A.D., when it gave way to the Coptic. During the time of Clement it was first learned by the beginners, who then proceeded to learn the hieratic; and afterwards the hieroglyphic, then an old and dead writing. The ancient Ethiopians carved hieroglyphics on their pyramids and monuments, as well as the Egyptians. The characters resemble those in use in the latter days of the Egyptian monarchy. Hieroglyphical inscriptions have also been found at Nineveh, Koyunjik, and in the islands of the Greek Archipelago. The term hieroglyphics has been applied to the picture-writing of the Aztecs, or ancient Mexicans. The subject delineated, such as a monarch or a town, was absolutely painted, and certain hieroglyphs were introduced in order to aid the explanation. The symbol expressing the king's name is attached by a cord over the head of the monarch; that of the town over it; and so on. After the introduction of Christianity, it is said that the monks used these symbols, according to their sounds, to write the Lord's Prayer and other religious formulas. The term hieroglyphics was applied by writers in the 16th century to emblems or devices symbolizing sentences taken from the Greek and Latin and having no relation to Egyptian hieroglyphics. Almanac-makers and astrologers have also applied the term hieroglyphic to the symbolical pictures which are supposed to be prophetic

of coming events.—*Ref.* Young's *Account of Discoveries in Hieroglyphical Literature*; Chabas' *Papyrus Magique d'Harris*; Birch's *Introduction to the Study of the Hieroglyphs.*

HIEROPHANT, *hi'-e-ro-fant* (Gr. *hieros*, sacred, and *phaino*, I show), in Antiq., a title applied to the chief priest who initiated candidates in the Eleusinian mysteries. He was obliged to be a citizen of Athens, and held his office, which was regarded as one of high religious importance, for life. In his duties he represented the Creator, and his privileges on public festivals were to adorn and carry the statues of the goddess. In consequence of his being the expounder of the sacred mysteries, he was termed the *mystagogus*, or *prophet*; and no one was permitted to utter his name in the presence of an uninitiated person. (*See* ELEUSINIAN MYSTERIES.)

HIGH CHURCH, an epithet first applied in English history in the year 1700, to those opinions which tended to exalt the ecclesiastical power, and also to the parties who embraced those opinions. At that period, the High Church party was thought unfriendly to the nation, and disposed to Jacobite principles. After the time of George I., the epithet lost whatever political force it originally possessed; and it is now applied in matters relating to the discipline of the church itself, in contrast to the term "Low Church," —the former attaching more value, and the latter less, to the dignities, ordinances, and ceremonials of the English church.

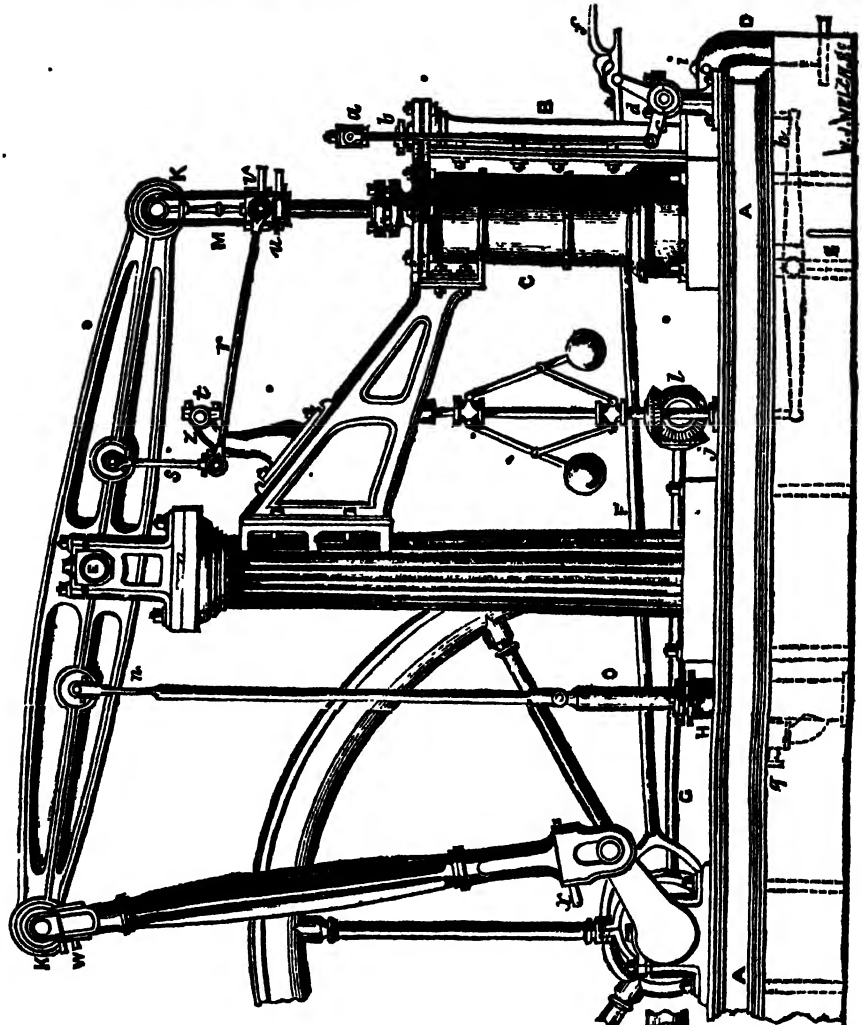
HIGH CONSTABLE. (*See* CONSTABLE.)

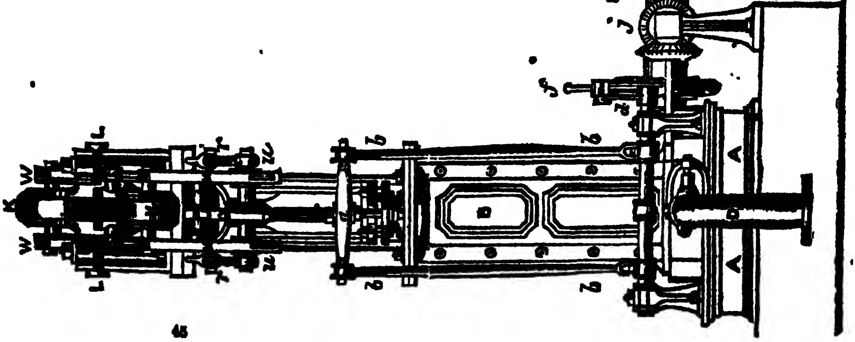
HIGHNESS, *hi'-ness* (Ang.-Sax.), a title of honour given to kings, princes, and others of royal blood. The titles of "highness" and "your grace" were both used by Henry VIII.; but towards the close of his reign he substituted "your majesty" in preference. The children of kings and queens are addressed as "your royal highness," while those of emperors are addressed as "your imperial highness." Among other titles, that of "highness" was conferred by Louis XIV. of France on the prince of Orange, in the year 1644.

HIGH-PRESSURE STEAM-ENGINE.—The simplest form of steam-engine is the non-condensing, or high-pressure engine, in which the condensing apparatus is dispensed with, and steam being admitted into the cylinder at a high temperature, and having acted on the piston, is allowed to escape into the air. (*See* STEAM-ENGINE.) A most ingenious and simple form of high-pressure steam-engine, the construction of Messrs. Murdoch, Aitkin, & Co., of Glasgow, is figured in the accompanying engravings. Although these gentlemen generally recommend the beam-engine, yet this form has many advantages over the beam; among others, the much less space it occupies. Messrs. Murdoch, Aitkin, & Co., in order to meet the variety of circumstances for which they have been required to furnish steam power, have found it expedient in many instances to adopt the character of engine here represented, and with uniform satisfaction. The principal castings are in this form lighter and less bulky than in the beam-engine, which, in many cases, is an object of consideration. The steam-cylinder A, of fig. 1, is cast open at both ends, and, after being bored and faced, is jointed down to the plate *a*, which is also turned and faced to receive it. The wings *w*, *w*, for fixing the guide-frames *g*, *g*, *g*, *g*, are cast on the cylinder, which also contains all the passages communicating between its interior and the valve *y*, shown in fig. 2, and also those between this valve and the eduction or waste-pipe E. The columns which carry the cylinder are cast in pairs. The pair between which the crank-shaft passes are cast together with the entablature joining their upper extremities, and having the crank-shaft pillow-block cast on the piece which unites their lower ends. The two pairs are bound together by the cross-piece of the entablature, which joins them, the bolts and nuts being out of view. This framing is secured to a sole-plate, which is open in the middle, to allow the crank to turn clear; and the whole is held down by bolts to a firm foundation building. The communication between the piston and the crank is effected by means of a cross-head (*m m*) on the piston-rod *p*, communicating by two side-rods (*g*, *g*) with the cross-head *o o*, with the crank-rod *h*; the side-rods and crank-rods are fitted and keyed into the cross-head *o o*, but are furnished with brasses at the crank-pin and upper cross-head (*m m*). This last has its ends projecting through blocks (*b*, *b*) in the guide-frames *g*, *g*, *g*, *g*, to maintain the vertical position of the piston-rod when in motion. The feed-pump F, for supplying the boiler, has its plunger, which is a plain rod, connected directly with the cross-head *m m*, and has, therefore, the same length of stroke as the piston. The valve-casing has a branch-pipe (S) cast on it, to join the steam-pipe which communicates with the boiler. The casing is jointed to the cylinder with red-hot cement, both faces being planed and fitted: it is also fitted with a door, giving access to the valve, and a stuffing box, through which passes the valve-spindle to the cross-head *n n*. The valve receives its motion from the traverse-shaft *t t* by two side-rods, which connect the levers on the shaft with the cross-head *n n*. The traverse-shaft is worked by an eccentric on the crank-shaft, the eccentric rod *e* having an open gab, which gears with a lever on the end of the traverse-shaft. The eccentric rod has also a joint in its upper end, communicating with the handle *k*, by which it may be disengaged from the traverse-shaft when required. The governor *r* is driven from the crank-shaft by bevel-gear, and communicates by means of levers with the throttle-valve *s*. The distinguishing feature of the kind of high-pressure steam-engine of 12-horse power figured here, is the single column made use of to support the main centre of the beam. The axis of the column is exactly under the centre of the beam; but the uppermost member of the capital is cast of an oblong shape, which enables it to serve as a platform, upon which the main centre pedestals are bolted down. To assist the bolts of these pedestals in withstanding the upward strains to which at intervals they are subjected, their soles are provided with dovetail recesses, into which correspondingly formed snugs, cast on the upper surface of the plinth, enter, leaving sufficient space on each side for fixing-keys to be driven in,—an arrangement which is fully shown in the side elevation of the engine at fig. 3. In this form of engine the column performs the whole work usually devolved upon a framing with four to six columns, with entablature; the single column having thus to receive and sustain both longitudinal and lateral strains, it is consequently of a much more massive character, and communicates to the engine a compact and solid appearance. The attempts which are so frequently met with to imitate the ancient column in structures of cast iron are rarely successful, and it would, perhaps, be more judicious to abandon altogether the classical modes, than to press them into use under circumstances of contrast to which they are not adapted. The cylindrical form is not the best adapted to withstand the strains to which the column is liable, and, accordingly, it is in some instances connected by a bracket to the cylinder, in the manner of marine engines. This bracket, besides strengthening considerably the whole framework, becomes available for carrying the fixed centres of the parallel motion, and likewise for carrying the upper end of the governor-spindle. When this bracket is omitted, as in some inferior examples, these centres must be sustained by other means; sometimes they are sustained by a short bracket erected on the capital of the column, but more commonly on the main pedestals. The governor-spindle is supported in the same manner. The species of parallel motion made use of in this machine is a modification of Watt's original motion, vibrating radii of unequal lengths being employed, the proportions of which are easily found by geometrical construction. The radius-rod has its fixed centre (*t*) in the bracket *z*, which rests upon the diagonal stay passing between the main centre column and the steam-cylinder. It is flexibly connected with the working beam *k k* by the links *s*, *s*, and to the parallel bars *r*, *r* at the same points. These bars communicate with the clutch of the piston-rod *v* in the usual manner. The clutch *v* is fixed on the top of the piston-rod by means of cotters and gib, which pass through it and the end of the piston-rod; and the extremities of the arms are carried in bearings formed by the strap-links M, M. These are open from the under end as high as the main centre of the beam, to receive the

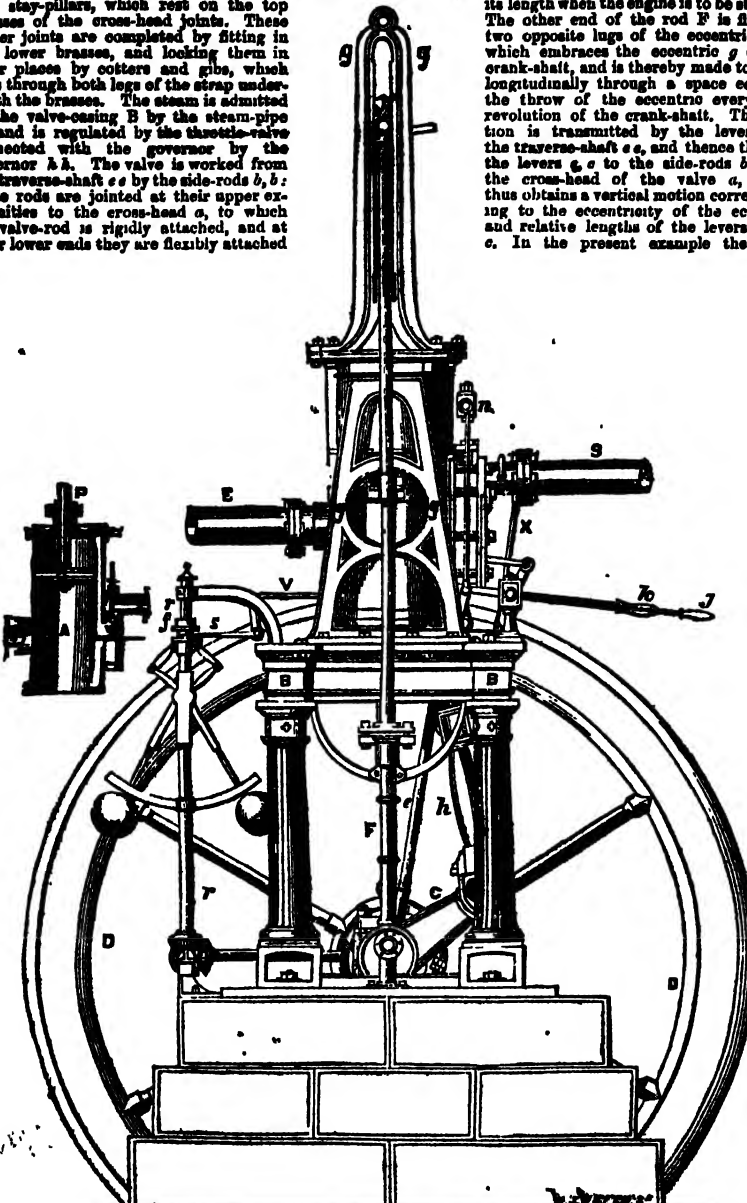
High-pressure Steam-engine

High-pressure Steam-engine





brasses for the cross-head and beam-joint. The top brasses of this last being fitted into their places, the under ones are supported against the centre pins by two stay-pillars, which rest on the top brasses of the cross-head joints. These under joints are completed by fitting in the lower brasses, and locking them in their places by cotters and gibs, which pass through both legs of the strap underneath the brasses. The steam is admitted to the valve-casing B by the steam-pipe D, and is regulated by the throttle-valve connected with the governor by the governor *h h*. The valve is worked from the traverse-shaft *e e* by the side-rods *b, b*: these rods are jointed at their upper extremities to the cross-head *a*, to which the valve-rod is rigidly attached, and at their lower ends they are flexibly attached



to the short levers *e, e*, projecting from the traverse-shaft *e e*. On one extremity of this shaft is fixed the lever, marked *d*, which has its projecting end rounded to enter a semicircular notch in the eccentric rod F, thereby forming a joint, which admits of the eccentric rod being lifted out of gear by a handle (*f*) projecting outwards in the direction of its length when the engine is to be stopped. The other end of the rod F is fixed to two opposite lugs of the eccentric ring, which embraces the eccentric *g* on the crank-shaft, and is thereby made to travel longitudinally through a space equal to the throw of the eccentric every half-revolution of the crank-shaft. This motion is transmitted by the lever *d* to the traverse-shaft *e e*, and thence through the levers *e, e* to the side-rods *b, b*, on the cross-head of the valve *a*, which thus obtains a vertical motion corresponding to the eccentricity of the eccentric and relative lengths of the levers *d* and *e*. In the present example these are equal, and, consequently, the travel of the valve is simply equal to the throw of the eccentric. The feed-pump H is worked directly from the beam of the engine by the rod *n*. This rod is jointed to the solid

plunger *o*, which works in a stuffing bolted on to the top of the pump-barrel. This arrangement has some advantage, in its being more easily fitted than when the stuffing-box is formed in the pump-barrel. The sole of the engine A A is firmly bolted to a stone foundation by long bolts, which pass through strong washer-plates in the lower course of the building, and are usually secured by cotters, but sometimes also by nuts, at their upper ends. All the parts are firmly bolted down upon the sole-plate, thereby giving to the engine a degree of portability and solidity which cannot easily be obtained by any other forms of framing. In order to complete the list of references to the accompanying engravings, we may conclude this article with the following:—A A is the sole-plate of the engine; B, the steam-chest, or valve-casting; C, the steam-cylinder; D is the steam-pipe; E, the escape-pipe; F, the eccentric rod; G, the shaft by which motion is communicated to the governor; H, the feed-pump barrel; K K, the working beam of the engine; L, the main centre of the beam; M, M, the links, or straps, connecting the piston-rod clutch with the beam; *a* is the slide-valve cross-head; *b*, *b*, slide-rods for cross-head; *c*, *c*, levers keyed on the rocking-shaft *e e*, jointed to the side-rods *b*, *b*; *d*, lever keyed on rocking-shaft, by which the latter is worked from the eccentric rod F; *f*, handle for disengaging the eccentric rod; *g*, the eccentric rod; *h*, lever connecting the governor-slide with the throttle-valve *i*; *j*, *k*, *l*, bevel-wheels and shaft for transmitting motion from the shaft G to the governor-spindle; *m*, sliding-ring of governor; *n*, force-pump rod; *o*, plunger for force-pump; *p*, pipe conveying cold water to pump; *q*, branch communicating with boiler; *r*, *r*, parallel bars for parallel motion; *s*, *s*, links connecting parallel bars with beam; *t*, fixed centre for radius-rods; *u*, *u*, keys for connecting the links or straps M to the beam; *v*, clutch on piston-rod; *w*, *w*, keys for tightening connecting-rod brasses at beam end; *x*, key for tightening brasses at crank end; *z*, pedestal for carrying the bearing for radius-rods.

High Priest, the chief priest and head of the Jewish synagogue, instituted by Moses, acting under the instructions of Jehovah. The importance of this office was indicated by the most gorgeous apparel, and the *high priest* was esteemed the most imposing personage of the nation. The dress of the functionary was characterized by his breastplate, termed the *urim* and *thumim*, or *light* and *right*, according to Luther's translation, composed of twelve precious stones, on which the names of the twelve tribes of Israel were inscribed. To him belonged the exposition of the oracles of God, and no other was allowed to enter the sanctuary, or holiest of holies, in the tabernacle, which he was only allowed to do once a year, in order to pray and sacrifice for the sins of the nation, which were believed to be thus expiated.

High Treason. (*See* Treason.)

High Water is defined to be the utmost flow and greatest elevation of waters acted on by tidal influence, and it is also a term applied to the time of such elevation. The time of high water depends on the age of the moon, and is nearly always the same at the same place at the full of the moon. High water lasts about fifteen or twenty minutes, after which time the tide begins to ebb. The method by which the time is found is as follows:—Add four-fifths of the days of the moon's age, considering them as hours, to the time of high water at the full of the moon, and the sum thus obtained will be found to be the time of high water answering to the day in question. *High-water mark* is the line made on the shore by the tide at its utmost height. (*See* Tidal Action.)

Highway. (*See* Way.)

Hilary Term, *hil'-ā-re*, an English legal term, commencing on the 11th and ending on the 31st January, during which time the courts of law sit *in banco* at Westminster. The name is said to be applied in honour of St. Hilary, bishop of Poitiers.

Hilum, or Umbilicus, *hi'-lum* (Lat.), in Bot., the point of attachment of the ovule, or the seed, to the *placenta* if sessile,—to the *funiculus* if stalked.

Hindoo Architecture, *hin-doo'*.—The oldest buildings that remain as examples of the early architecture of India are considered by competent judges not to have been erected earlier than 300 years prior to the Christian era. Indian architecture may be broadly classified as Buddhist, Brahman, and Mohammedan, which three styles derive their names from the religion professed by the dominant power in India during the period in which each prevailed; Buddhism giving place to Brahmanism, and Brahmanism yielding in its turn to the Mohammedan form of worship, introduced by the Saracenic conquerors of India about 1000 A.D. There are many points in which the architecture of Hindostan bears a striking resemblance to that of Egypt, temples being found in both countries that have been hewn out of the solid rock, and ornamented with statues attached to piers or walls, which are remarkable for their size and colossal proportions. The chief, and, indeed, almost the only, remains of Buddhist architecture, with the exception of the *topes*, or structures built to contain relics of Buddha, are the cave temples found in southern India, the principal of which are the temples of Elephanta and Salsette, near Bombay; Behar, Cuttack, and those of Ellora and Carli, in the province of Aurungabad. These temples consist of excavations cut out of the solid rock with considerable labour; and in addition to the temple itself, monasteries, if they may be so termed, are also hewn out of the stone in the same manner in some localities, to afford accommodation for the priests who were in attendance on the shrine of the divinity. The rock-temple of Carli is supposed to be one of the oldest of these curious excavations. It consists of a nave about 26 feet in width, separated from narrow aisles on either side by rows of massive pillars. The entire length of this temple is 126 feet, and its breadth about 47 feet. The roof is vaulted, and rises about 46 feet above the level of the floor in the centre. The columns on either side of the nave consist of a base, shaft, and capital. The base is very high, especially when compared with the bases of columns used in the various styles of European architecture; the shaft is octagonal, and about equal to the base in height; while the capitals are ornamented with kneeling elephants, on which male and female figures are seated. Entrance to the body of the temple is obtained through three doors, the largest being in the centre, and the two smaller ones on either side of it. There is a porch before these doors, which extends along the whole *façade* of the temple and a few feet beyond it; and above them is a gallery. The space above the gallery up to the roof itself is entirely open, forming a large semicircular window, by which light is admitted into the interior. The temple terminates in a semicircular apse, surmounted by a semi-dome, and in this apse the shrine and image of the divinity are placed. The temple of Elephanta is much larger, and excavated in the side of a mountain; it is about 130 feet square. It is filled with rich and varied sculpture, consisting chiefly of colossal figures in *alto relievo*. The columns are composed of a fluted shaft swelling outwards in the middle, standing on a high square base, and surmounted by a bulb-shaped circular capital, which is one of the chief distinctive features of Indian architecture. The Buddhist rock-monasteries consist of a series of cells ranged round a central hall. They are not so richly ornamented with sculpture as the temples; but many of the chambers are decorated with paintings representing events in the life of Buddha, and portraits of Buddha himself and Buddhist saints. The topes are generally in the form of circular buildings surmounted by a dome. They vary from 10 or 20 feet in diameter to 180 or 200 feet, and for the most part consist of a solid cupola erected on a flat terrace reached by steps, with a relic-case called a *tee*, or a square ornament in the form of a box, intended to represent a relic-case, on the summit. A column called a *lât* was placed in front of the Buddhist religious buildings, on which the Buddhist creed was inscribed. Some of the Buddhist temples in Ceylon, Burmah, and Java consist of a series of terraces rising above one another in a pyramidal form, with a relic of Buddha under a dome at the summit. (*See* Boro Buddor.) On the decline of the worship of Buddha in India, a sect known as the Jains, or Jainas, sprang up. The temples erected by the Jains were characterized by great elegance and lightness of structure, combined with richness of ornamentation. They consist of a central dome, surrounded by others

more or less in number, supported on sculptured columns. The ceiling of the cupolas, which are hollow and not solid like the domes of the topes erected by the Buddhists, are panelled and adorned with elaborately designed scroll-work and foliage. The temples of the followers of Brahma consist of an inner temple, or sanctuary, called the *bimana*. This is in the form of a four-sided pyramid, which rises to a great height, and is formed of a succession of steps or terraces, adorned with figures and sculpture, and crowned by a small dome. In this was the cell, or sanctuary, which contained the image of the deity, and was lighted by lamps. A porch was placed before the entrance to this inner sanctuary, and the entire pile formed the centre of a rectangular court, surrounded by a high wall. The entrance to this court was flanked by pyramidal gate towers, called *gopuras*. Halls, or colonnades, consisting of a roof, supported on pillars, varying in number from four up to a thousand, according to the size of the building, were erected in the inclosures that surrounded the Brahman temples. These halls were called *choultries*: they served for the celebration of festivals and ceremonies connected with the worship of Brahma, that occurred at various seasons of the year. The temples at Tanjore and Bareilly are the best examples of this style of Indian architecture. When the Mohammedans conquered India, they introduced the arch, and various features of Saracenic or Moorish architecture, which were gradually blended with the more prominent features of the previous styles prevailing in that country, until a new style was produced similar in many respects to the architecture of Arabia, Northern Africa, and Spain, when the Saracens had the mastery over those countries, but containing other characteristics, which are sufficient to mark it as a distinct style. The ornamentation is as rich and minute in detail as that of Moorish architecture, and the pointed and horse-shoe arch are introduced in a square panel, but the bulbous cupolas swelling outwards, and extending considerably beyond the circle of the base, as well as the projecting galleries of the minarets and balconies, supported on cantilevers of great length, are peculiar, and belong entirely to the Mohammedan architecture of India. The mosques, and some of the tombs erected by the great Mohammedan sultans of India, afford the best examples of this style of architecture. Among these may be named the great mosque at Delhi, and the magnificent mausoleum built by Shah Jehan, near Agra, about 1640, to the memory of one of his queens. (*See* TAJ MAHAL.)—*Ref.* Fergusson's *Handbook of Architecture; English Cyclopædia*—Arts and Sciences.

HINDOOISM, *hin'-doo-izm*, a term applicable to the religion and social customs of those inhabitants of Hindostan who profess the worship of Brahma. One of the principal features in Hindooism is the system of caste, which divides society into four orders. (*See* CASTE.) The manners, customs, and laws of Hindoos are so intimately connected with their religion, that they can scarcely be described separately. The division into castes is a religious institution, which includes the whole detail and intercourse of life. The Brahmins, or the first of these castes, are the priests of their religion, which is a polytheism, or worship of many gods. The great vagueness of the Brahminical language with respect to the attributes of the gods, the long catalogue of fictions tacked on to their exploits, and the endless ramifications of sects, render any clear definition of the Hindoo religion very difficult. The code of Menu is one of the principal foundations of Hindoo faith, and is, besides, one of the few sacred documents out of which anything approaching to a precise idea of Hindooism can be extracted. Its date is given at about 600 B.C.; yet it yields in high antiquity to the Vedas, or sacred books of the Hindoos, the ages of which are stated at from eight to ten centuries before Christ. The code of Menu, however, has the advantage of being comparatively clearer than the older books, and is thus of more value to a modern student. All the sacred books of the Hindoos, although they inculcate the moral duties of justice, mercy, and benevolence, yet seem, like every system of false religion, to give the first place to the ceremonial law. The devotion of the Hindoos, consequently, consists in mere outward observances, and is not inconsistent with the most disgraceful crimes. The great triad of the Hindoo divinity is composed of Brahma the Creator, Vishnu the Preserver, and Siva the Destroyer; while beneath this trinity lurks the incomprehensible Brahm. Hindoo adoration, for the present period, is reserved for the Destroyer and the Preserver, Brahma having only one temple subsisting to his honour. The worship of this god ceased about the commencement of the Christian era. According to the Hindoos, the constant interposition of the Deity is required to maintain a proper balance in earthly affairs. Vishnu the Preserver is represented in the sacred books as having passed through ten incarnations, called Avaters. The first is the avater of the fish, when the world is described as being destroyed by a deluge. In the second avater, Vishnu, issuing from the side of Brahma in the shape of a boar, grows in an hour as large as an elephant, and remains suspended in the air, while a malignant giant rolls up the earth and flings it down into an abyss. Vishnu, however, descends into the water, and brings up the earth again on his tusk, spreading it out "like a carpet on the face of the water." In the third avater, Vishnu and Brahma churned the ocean like a "pot of milk," in search of the *amreeta*, or water of immortality. In the fourth, he appeared as a man with the head of a lion. In the fifth, sixth, and seventh, Vishnu goes through a course of adventures in seeking out impious and cruel kings, and punishing them. In the eighth avater, he appeared as the beautiful Crishna, the shape in which he is most frequently worshipped. The ninth avater was the incarnation in the person of Buddha; while the tenth avater is still to come. Vishnu is then expected to appear mounted on a white horse, with a scimitar blazing like a comet, to mow down all incorrigible offenders who shall be living on earth. As the Hindoos began by dividing the divine power among a triad of rival gods, they soon began to split up into sects, each sect holding its own god to be the only true god. The followers of Vishnu and Siva invented new symbols, ascribing each, to their respective divinity, the attribute of creation. This contention for superiority ended in the total suppression of the worship of Brahma, and the temporary submission of Vishnu to the superior Siva. This, however, did not last long, and crusades were raised by the sects against each other. All the Hindoos, however, believe in one mysterious pre-eminent power, which they call Brahm, a power which can not only absorb the universe but all the gods. This absorption into the essence Brahm is the highest reward of the holy Hindoo. In order to attain this state of beatitude, a large number of injunctions have been laid down, to which he must duly attend. He must injure nothing animated, must subdue all sensual appetite, and perform all the rites prescribed in the Vedas. As the divinity can only be approached in a state of the greatest purity, and as the supposed causes of impurity are exceedingly frequent and numerous, the Hindoo has to perform a great number of religious ceremonials every day of his life. The modes of purification are very various and strange, many of them being very ridiculous. Of these bathing is the most rational: the other modes are by stroking a cow, looking at the sun, or having the mouth sprinkled with water. Inanimate objects need purification also: land is made pure by sweeping, by scraping, by allowing a cow to pass a night upon it, &c.; folded clothes must be sprinkled with hallowed water, and wooden utensils planed. The expiation of sin by voluntary penance is another favourite doctrine of the Brahmins, by which they contrive to awe superstitious minds into subjection. To such an extent will this fanaticism carry the Hindoo that he will, as travellers have witnessed, keep his hands clenched till they are pierced by the growth of his nails; or hold his arms upraised till the limbs become paralyzed; or vow to remain in a standing position for years. Such spectacles have been frequently witnessed among the wandering professors of penance called Fakirs. (*See* FAKIR.) The junction of the Ganges and the Jumna is a place of peculiar sanctity, and a favourite dying-place of the devout Hindoo. Many of them drown themselves at the junction of the streams every year, and the rapidity with which the victim sinks is a token of his favourable acceptance by the god of the river. In order to gain

the good graces of the deity, the devoted person, with pots of earth fastened to his feet, is carried out into the middle of the stream. The devout multitude contemplate the scene from the surrounding banks, and applaud the victim if he retains a steady and resolute countenance to the last. The highest mode of sacrifice, however, is that of the wife who consents to be burnt alive with the dead body of her husband. In such case, should her husband have even killed a Brahmin, broken the ties of gratitude, or murdered his friend, she expiates the crime. The ancient and widely-diffused doctrine of metempsychosis, or transmigration of the soul, is also one of the Hindoo doctrines. The reward, however, of the highest virtue of the soul long engaged in pure and profound meditation, and of exquisite abstemiousness, is, that it shall be absorption into the divine essence, when it shall ever after be exempt from transmigration.

HINDOOS, LITERATURE OF THE.—In common with their religious traditions and the invention of their alphabet, the literature of the Hindoos is of the highest antiquity. Nearly all the literary compositions of the Hindoos are in verse. "For history," says Mill, "they have only certain narrative poems, which depart from all resemblance to truth and nature, and have evidently no further connection with fact than the use of certain names and a few remote allusions. Their laws, like those of rude nations in general, are in verse. Their sacred books, and even their books of science, are in verse; and, what is more wonderful still, their dictionaries." Because men feel before they speculate, therefore is poetry, which is the earliest form of expressing the feelings, the first literature. At this primary stage has the literature of the Hindoos remained. To commence with the Sacred Literature:—Under the general term of SHASTRAS, the Hindoos possess the four *Vedas*, named respectively the Rig, Yajash, Sama, and Atharva; the four *Upavedas*, or Sub-Vedas, the Ayush, Dhanush Ghandarva, and Artha; the *Vedanga*, or Six Angas; and, finally, the *Upangas*. The *Vedas* are written in Sanscrit (*see* HINDOSTAN, LANGUAGES OF), as is the Mantras, or prayers, the Brahmanas, or commandments, and, in short, the whole body of Hindoo theology proper. The *Upavedas* form a second class of sacred books, and consist of treatises upon surgery, medicine, music, dancing, war, architecture and many mechanical arts. The *Vedangas*, or Six Angas, are treatises subsidiary to the Vedas, and comprehend—rules for reciting the Vedas, and especially as regards the accents and tones to be observed; a treatise on grammar; besides dissertations upon metres, astrology, and astronomy. These works are held to have been given by inspiration of God to enable the Brahmins to read and understand the Vedas. Thus, we here perceive a double inspiration,—that of the Vedas and that of the Angas, the latter forming the key by which the Vedas are opened. The *Upangas*, or inferior bodies of learning, comprehend logic, theology, the institutes of the law, and certain legendary treatises, to the number of eighteen, which bear the name of *Puranas*. We will give a brief sketch of these latter. 1. The Kalika Purana contains a history of the goddess Kalika Parvadi, the wife of Siva. 2. Abhiatma Ramayana is a fragment of the history of Ramatshandra. 3. Brahma Vaivartika treats of the origin of the gods and the history of Ganesa, Crishna, and Durga. 4. Pedma Purana is the praise of the lotus (*pedma*), and a history of Lakshmi, the wife of Vishnu, in 55,500 stanzas. 5. Agni Purana forms a sketch of all Hindoo science, in 15,500 stanzas. 6. Vishnu Purana, in 23,000 stanzas. 7. Siva Purana, in 24,000 stanzas. 8. Linga Purana. 9. Scanda Purana, of the god Scanda, the son of Siva and Bhavani. 10. relates to religious customs. 11. Ontkal Khanda and Kasi Khanda; the former a description of Orissa and the old religious rites of Vishnu; the latter a history of the city of Kansi, now Benares. 12. contains the history of Nareda, the god of music, in 25,000 stanzas. 13. Markandeya Purana. 14. Bhawisia Purana. 15. Vaya Purana, the history of Vaya, the god of the winds. 16. Matsya, the history of Vishnu as the fish, in the first deluge. 17. contains the history of the same god as a man-lion. 18. treats of the history of Crishna, or Vishnu, in 12 books. The two oldest and most important epic poems, which are also classed among the sacred books, are the "Ramayana," containing the history of Ramatshandra, king of Ayodya, the seventh great incarnation of Vishnu; and the "Mahabharata," detailing the war of the Pandus and Kurus, consisting of 18 books and upwards of 100,000 stanzas. We shall now proceed to touch, in a brief manner, upon the Profane Literature of the Hindoos, noticing the principal works. The "Mugdhabodha," or Beauty of Knowledge, by Goswami, is held to be the best Sanscrit grammar. There are in all eighteen dictionaries of high reputation, but the "Amarasinha" is deemed the best. The poetry of the Hindoos betrays throughout an elegiac earnestness and sweetness which owes its origin to their oldest poet, Valmiki, who sang in plaintive strains the murder of a youth who lived happily with his mistress in a beautiful wilderness, and was mourned by her in heartrending lamentations. Among the dramatic poets is Cahdas, who has been called the Hindoo Shakspere. His finest drama is "Sakoontolah," or the Fatal Ring, which has been translated into English by Sir William Jones, and into German by Forster, Herder, and others. According to Herder, the scenes of this great drama "are connected by flowery bands; each grows out of the subject as naturally as a beautiful plant. A multitude of sublime as well as tender ideas are found in it, which we should look for in vain in a Grecian drama." Another great drama of this author is the "Megha Duta," or Cloud-Messenger, which has been rendered into English by Wilkins. The Hindoos have two kinds of feet in their verses, and also two kinds of rhyme; the one falls on the first letter or first syllable of the verse, and is called *yety*, or *vadi*; for example, *ki* in *kirti* and *kirtana* make a rhyme. The other falls on the second letter or second syllable from the commencement, and is called *prasam*; for example, *pa* in *capaguy* and *dipantram*. Among the most important philosophical works of the Hindoos, there are,—"Gangheswara Fatwa Schirtamahi," which is a treatise on metaphysics; "Pratikhya Tippani," a commentary on visible objects; "Anumaka Didhiti," is a treatise on memory; "Smriti Tatwa," is an abstract of the laws; and "Hitopadesa," a Hindoo book of fables, called also the Fables of Bidpay or Pilpay. This latter was the first work published in Europe in the Hindoo language. It appeared in 1810.

HINDOSTAN, LANGUAGES OF, *hin-dos-tân'*.—A survey of the languages, no less than of the antiquities and the religious systems, which prevail in India, would seem to afford a sufficient proof that its inhabitants are a primitive people, and that its territory is truly *Medyama, Medhya-Dehsa*, 'the central land.' Our knowledge of the philology of this strange and wildly-magnificent country is due to the labours of the missionary Henry Roth and the Jesuit Hanselben, and, since 1700, to the more searching investigations of Paolino, Sir W. Jones, Wilkins, Forster, Carey, Marshman, Wilson, Colebrooke, Marsden, Bopp, and others. Following Colebrooke, who took a Hindoo treatise upon rhetoric as his guide, we find there are four principal languages,—Sanscrit, Pracrit, Paisachi or Apadhransa, and Magadhi or Misra; the Apadhransa and Magadhi being considered the same, and the Misra and Paisachi as one: so that in reality the leading languages are the Sanscrit, the Pracrit, and the Magadhi. This is the opinion of the last-quoted author; but other English critics maintain that this statement requires considerable qualification. 1. The Sanscrit, known also as Gronthon (from *grandha*, book), is the sacred language of the Brahmins and of literature. Now a dead language, there is strong presumptive evidence that it was once a spoken tongue. Singularly copious, and perfect in construction to a degree, its alphabet, consisting of fifty letters, is termed *Devanagari* (the divine alphabet), on account of its supposed origin with the gods, whose language it is. It has three genders, a dual like the Greek, conjugations numbered according to the vowel or consonant endings; seven cases, after-nouns (instead of pronouns), and an abundance of particles. The period of its highest perfection was in the last century preceding the Christian era, when the great poet Calydos flourished, the author of "Sakoontalah" (the Fatal Ring) and of the "Megha Data" (the Cloud-Mes-

senger). In the Sanscrit, also, are written the old sacred books of the Vedas. The founder of the Sanscrit grammar is Pannini, the supposed author of the "Sutras," or short grammatical precepts. His system was improved by Catugayana, in a work called "Mahabhashia," which again was amended by Caiyata. Perhaps the most celebrated of the later works upon the grammar of the Sanscrit tongue are the "Casica Vritti," and the commentary upon it by Haradatta Misra, entitled "Padamanjari." Among the best modern grammars are those of Colebrooke and Wilkins. Coming to dictionaries of the Sanscrit, we find the "Amara Cosha," or the Treasure of Amara Singh, a writer who flourished anterior to the Christian era; the "Viswapracasa" of Maheswara, and the "Haravali" of Purushottama. By English authors, we possess the "Dictionary in Sanscrit and English," of Professor Wilson; the "Sanscrit and English Dictionary," printed at Calcutta in 1846 the "Elementary Introduction to the Sanscrit Language," by Monier Williams, &c. The learned Sir William Jones established in 1808, at Calcutta, a printing-office for the production of Sanscrit works, and to this great Oriental scholar we owe the comparatively deep acquaintance we possess of the Sanscrit, —a language that would be important for the literary treasures of which it is the storehouse, but which becomes in the highest degree valuable when we reflect that it contains the fundamental sounds of all the European languages. (*See* INDO-GERMANIC LANGUAGE.)—II. The Pracrit is the common language, and comprehends within itself the various dialects used in writing and in social intercourse. Colebrooke mentions ten; but to these should be added the Punjabee and the Brija Bhasha. The five following dialects constitute the languages of Northern and Eastern Hindostan:—1. The Sareswata, spoken by the people who dwell upon the river of this name, a stream flowing through the Punjab: it is a language rich in dramas and poems. 2. The Kanyacubja, which appears to be the parent of the modern Hindostanee, interlarded with Persian and Arabic words. 3. The Bengalee, a dialect principally spoken in Eastern Hindostan: it is rich in translations from the Sanscrit, and forms, almost exclusively, the language of the learned Hindoos. Its alphabet is a close copy of the Devanagari. 4. The Mitilaw, or Tirhoot, is the chief language of Mitilaw, or the circle of Tirhoot, and the neighbouring districts lying between the rivers Cusi and Gundhac, and the mountains of Nepaul. 5. The dialect of Orissa, called Uriya. The five following form the languages of the southern extremity of the Deccan, of the Mahrattas, of the people inhabiting the middle of the Mysorean plateau, of the inhabitants of the tract of country lying between the Krishna river and the Godavery, and of the Guzeratese. They are named respectively the Dravida, the Maharashtra or Mahratta, the Carnata, the Tailanga, and the Gurjara or Guzerat.—III. The Paisachi, or Apadhransa, has been presumed to be a mixture of the dialects of mountaineers and the Sanscrit. It is never alluded to in dramatic writings, except to serve as a subject of ridicule.—IV. The Magadhi, or Misra, presumed to be analogous with the Pali and Magadhi of the Cingalese, is the language of the priests of Buddha. In common with the Chinese, the foundation of this series of dialects is monosyllabic. Broadly speaking, it may be said to comprehend all the various dialects spoken by the peoples inhabiting the coast and islands lying between India and China.

HINGE, *hinje* (Ang.-Sax.), a contrivance by which doors are fastened, or hung, to one of the jambs of a doorway, and on which they turn when they are opened or shut. It is also used to fasten shutters or casement windows to the window-frames, gates to gate-posts, and lids or covers to boxes. The simplest form of the hinge, and that which fully shows its principle of construction, is the common socket and staple by which gates are usually hung. The common hinge consists of two plates of metal, with hollow cylinders attached to each in such a manner that the cylinders projecting from one piece fit into the spaces between or at either side of the cylinders in the other piece, an iron pin about which they turn being driven through the perforated cylinders so as to fasten the whole together. There are many varieties of the common hinge, distinguished by technical names, some being in the form of two rectangular parallelograms of brass or iron, fastened together by an iron pin, while others, chiefly used for common doors and boxes, consist of two long tongues of iron similarly held together. In the rising hinges used for doors in the better class of houses, the cylinders that move about the central pin are divided by a curved line in a direction similar to that taken by the thread of a screw. This arrangement causes the door to rise when it is opened, and to swing to and fro freely without touching the carpet. Some kinds of hinges are constructed in such a manner that the doors to which they are attached will open readily either inwards or outwards. Those frequently have a spring attached to them to cause the door to close immediately. The doors of banks and places of public resort are generally hung in this manner, to allow of ready ingress or egress. In Gothic ecclesiastical architecture, the hinge was frequently made an ornamental feature, the doors of churches being frequently covered with elaborate scroll-work branching from the central part of that portion of the hinge which was fastened horizontally on the exterior of the door. A good example of a hinge of this sort may be seen on the principal entrance to St. Saviour's church, Dartmouth.

HIPPOCAMPUS, *hip-po-kam'-pus* (Gr. *hippos*, horse; *kampto*, I bend), the *H. brevirostris* of Cuvier, a species of lophobranchiate fish, belonging to the family of the *Syngnathidæ*, which is known in England by the appellation of the Sea-horse or Pipe-fish. Its generic characters are: jaws united and tubular, like those of the *syngnathi*; the mouth placed at the end; the body compressed, short, and deep; the whole length of the body and tail divided by longitudinal and transverse ridges, with tubercular points at the angles of intersection. Both sexes have pectoral and dorsal fins, neither have ventral or caudal fins, and the female only has an

HIPPOCAMPUS.

anal fin. The length of the *hippocampus*, from the point of the nose to the end of the tail, is generally about five inches; the form of the body heptangular, and the number of segments into which it is divided about thirty. Its general colour is a pale ash-brown, relieved by a changeable iridescence; and variable tints of blue are dispersed over different parts of the head, body, and tail. With regard to the habits of this fish, [illegible] quickly [illegible] in any direction round the weeds, and, when fixed, the animal attently watches the surrounding objects, and darts at its prey with great dexterity." It is stated that the food of the *hippocampus* is unknown; but it is most probable that it resembles that of other *syngnathi*, and, consequently, consists of worms, small molluscs, and the ova of other fishes.—*Ref.* Yarrell's *History of British Fishes*.

HIPPOCRATEACEÆ, *hip-po-krai-te-ai'-se-e*, in Bot., the *Hippocratea* fam., a nat. ord. of *Dicotyledones*, subclass *Thalamifloræ*,—shrubs with opposite simple leaves and small deciduous stipules. Flowers small, regular, and unsymmetrical. Sepals and petals 5, hypogynous and imbricated, the former persistent. Stamens 3, hypogynous and monadelphous; the anthers with transverse dehiscence. Ovary 3-celled, with a single style. Fruit baccate, or consisting of 3 samaroid carpels. Seeds definite, exalbuminous; embryo straight; radicle inferior. The plants of this order abound principally in South America; some are found in Africa and the East Indies. Some have edible fruits, as the species of *Tontalea*, found in Brazil and Sierra Leone. *Hippocratea comosa* yields oily and sweet nuts.

HIPPODROME, *hip'-pod-rome* (Gr. *hippos*, a horse, and *dromos*, a racecourse), in Ancient Arch., a place appropriated by the Greeks to equestrian exercises, and in which prizes were contended for during the celebration of some of the Olympic games. (*See* GAMES.) The most remarkable of all the Grecian hippodromes was certainly that built at Olympia, which is stated by Pausanias to have been four leagues long and one in breadth. The one at Constantinople still remains, and may well create a feeling of astonishment in the mind of travellers, as it usually does. This latter was built in imitation of the grand circus at Rome, and was adorned with statues, both of marble and bronze; amongst the most important of which, it may be stated, were the fine bronze horses of Lysippus, possessed by Venice, which formerly ornamented the hippodrome of Constantine. The word itself is still in use, and is, even now, applied to circuses and other buildings set apart for equestrian purposes.

HIPPOPHAË, *hip-pof'-ă-e*, in Bot., a gen. of the nat. ord. *Elæagnaceæ* (which *see*).

HIPPOPHAGI, *hip-pof'-ă-ji* (Gr. *hippos*, a horse, and *phagein*, to eat), a term applied, in Ancient Geog., to a people of Scythia that fed on horseflesh. The descendants of these—the Kalmuck Tartars of the present day—still retain the peculiarities of the Scythians, and esteem horseflesh as a dainty. (*See* HORSE.) Many attempts have been made in Europe to introduce the flesh of the horse as an article of food; but all have been failures, with the exception of one made recently in Paris by some *savans*, who have formed themselves into a club of *hippophagi*, for the express purpose of spreading a taste for horseflesh amongst all classes of society. Whether these modern hippophagi will meet with success in their endeavours to create a new system of animal food, remains to be proved.

HIPPOMANE, *hip-pom'-ă-ne*, in Bot., a gen. of the nat. ord. *Euphorbiaceæ*. The species *H. mancinella* is the famous manchineel-tree, which is asserted to be so poisonous that persons have died from merely sleeping in its shade. It flourishes in the Antilles and on the American continent, near the sea, and forms a very handsome tree, with foliage not unlike that of the pear-tree. The juice which fills the tree is of a pure white colour, and when dropped on the hand, it burns like fire, forming an ulcer very difficult to heal. Seemann states, that if sea-water be applied to the eyes when affected by the poison, it allays the inflammation in an effectual manner. The fruit, which resembles a very beautiful apple in appearance, contains a similar juice, but of a milder character. The burning of the lips immediately warns those who bite it of the danger of eating it. The timber is beautifully variegated, and susceptible of a high polish. It takes its name from the Gr. *hippos*, a horse; *manomai*, I rage.

HIPPOPOTAMUS, or RIVER-HORSE, *hip-po-pot'-ă-mus*, (derived from the Gr. *hippos*, the horse; *potamios*, of the river), a pachydermatous animal, which inhabits most of the rivers of Africa. Its generic characters are,—four toes on all the feet, inclosed in small hoofs; six molar teeth on each side of both jaws; large and strong canines, of which the upper ones are nearly straight, the lower ones curved, and working upon each other so as to produce a chisel edge; four incisors in each jaw, the upper ones short and conical and bent inwards towards the mouth, the under ones long and cylindrical, and pointing outwards. The skeleton of the hippopotamus approaches that of the ox and of the hog; but it presents also wide differences, which separate it from classification with any other animal. From the structure of the teeth, it is evident that the quantity of vegetable matter supplied to the digestive organs must be very great in proportion to the nourishment derived from the same, as the principle on which its jaws are formed seems more for the purpose of tearing and rudely dividing than thoroughly masticating the tough grasses and vegetables which form the staple food of the animal. The hippopotami live during the daytime immersed in the waters of their native rivers, and at night come to land for the purpose of feeding, when they do an enormous amount of damage to the neighbouring fields, not only from the large amount of produce that they consume, but also the still greater quantity which they tread under foot and lay waste with their ponderous, bulky proportions. From their being able to breathe under water, they appear to be possessed of some muscular arrangements for closing the nostrils, as is seen in seals and other marine animals. Remains of different species of hippopotami are often found in the tertiary geological formations of Europe; and in the tertiary stratas at the foot of the Himalaya mountains, in Hindostan, an extinct species of hippopotamus has been discovered, which had six incisor teeth in each jaw. Bochart identifies the hippopotamus with the *Behemoth* mentioned in Scripture; but Cuvier, while agreeing with him that the identity is possible, still asserts that the description given in the book of Job is not sufficient to place the matter beyond doubt. That it was known to the ancients is conclusive from the fact that Herodotus, Aristotle, Pliny, and Diodorus, each and all give descriptions of the animal. The specimens of the hippopotami in the gardens belonging to the Royal Zoological Society in Regent's Park consume daily upwards of 100 lb. weight of hay, chaff, corn, roots, and other green food.

HIPPURIC ACID, *hip-pu'-rik* (Gr. *hippos*, horse; *ouron*, urine), an acid contained in the urine of the herbivora. It is most easily obtained from that of the cow, which, according to Boussingault, contains 1·3 per cent. It crystallizes in rhombic prismatic masses. Hot alcohol and water dissolve it readily, but it only dissolves in 600 times its weight of cold water, and is almost insoluble in ether. It has a bitter taste, and reddens litmus-paper powerfully. By dry distillation, it is converted into benzoic acid, and a reddish oil of an agreeable odour. It forms salts with the alkalies, which are very soluble.

HIPPURIS, *hip-pu'-ris*, in Bot., the Mare's-tail, a gen. of the nat. ord. *Haloragaceæ*. *H. vulgaris* is an insignificant plant, common in stagnant water and slow streams. The stem is simple, or sometimes branched at the base, and erect. The leaves are linear, pointed at the end, and growing in whorls of from six to twelve. The flowers are minute, and often without stamens: they are produced in the axil of each of the upper leaves.

HIPPURITE, *hip'-pu-rite* (Gr. *hippos*, horse), in Geol., massive horsehoof-like bivalve of the chalk formation, having a deep conical or sub-cylindrical under-valve, with a flattish lid, or upper valve.

HIPPURITES, in Geol., a gen. of fossil plants of the coal-measures, so called from their close resemblance to the *Hippuris vulgaris*, or mare's-tail. If they grew in the same relative proportions as the existing plant, many of the fragments found would indicate a height of 1[?] or 20 feet.

HIRUDO. (*See* LEECH.)

HIRUNDO, *hir-un'-do* (Lat., a swallow), a genus which forms the type of the fissirostral or wide-gaping birds, belonging to the passerine tribe of the Cuvierian system. (*See* SWALLOW.)

HISTOLOGY, *his-tol'-o-je* (Gr. *histos*, a web; *logos*, a discourse), a term identical, or almost so, with general minute anatomy, or microscopic anatomy. Histology classifies and describes the structural or morphological elements which exist in the solid and fluid parts of organic bodies. This science did not make any great progress until the commencement of the present century, when the invention of the compound microscope caused its advancement. Its origin, however, may be traced back to Malpighi, who lived in the 17th century, and discovered the blood corpuscles. In later times, very valuable discoveries have been

made by uniting the use of the microscope to experimental chemistry. The structure of different horny tissues was thus first shown; and it was proved that whalebone, nails, and cow-horn, are similarly composed of aggregations of diminutive cells. Histology has also been useful in the investigation of the nervous tissues, and of many other structures. No department of medical science has made such rapid progress as histology in late years. Kölliker, Leydig, Frey, and

Clarke, Beale, Queckett, Bennett, Goodsir, and Lockhart.

History, *his'-to-re* (Gr. *historia*, from the verb *historeo*, I inquire), means literally an account of facts. It is a word first used by Herodotus, who calls his work by the title "Historia;" and there can be but little doubt that this ancient writer fixed the sense in which the word has since been applied; that is, as meaning the science which treats of man in all his social relations, religious, moral, commercial, political, or literary, as far as these are the result of general influences extending to large masses of men. Embracing both the past and present, *history* consequently considers everything which acts upon men,—regarding them in the light of members of a society. It should clearly represent the relations in which man exists towards his brother men, and should detail the influences to which he is subjected, the motives by which he is actuated, and the inferences drawn from the same, with clearness and truth. According to some commentaries, history may be either considered in the light of an intellectual exercise in the department of human knowledge or science, or as a form of literary composition. Bacon reckoned it as the chief component part of learning, and studied it in its relations to memory, while he placed philosophy and poetry below it, as appealing only to the understanding and imagination. It is therefore the business of history to record or remember the events, past and present, of the world, and to place them down in such a way that they can have the best hold on the memory, by appealing to other facts for their support and corroboration. This is the true definition of the word used by Herodotus, although it has been analogically used to express other branches of investigation; as in the term *natural history*, still in use; and some of the ancient writers defined the general use of the word by their adaptation of it; as Aristotle's "History of Animals," and Theophrastus's "History of Plants." Dr. Arnold, in his "Lectures on History," remarks on the widely different interpretations of the word, and also explains its correct meaning. "The general idea of history," says he, "seems to me to be that it is the biography of a society; it does not appear to me to be history at all, but simply biography, unless it finds in the persons who are its subjects something of a common purpose, the accomplishment of which is the object of their common life. History is to the common life of many what biography is to the life of an individual. Take, for instance, any common family, and its members are soon so scattered from one another, and are engaged in such different pursuits, that, although it is possible to write the biography of each individual, yet there can be no such thing, properly speaking, as the history of the family. But suppose all the members of the family to be thrown together in one place, amidst strangers or savages, then these immediately enter a common life,—a unity of action, interest, and purpose, distinct from others around them, which renders them at once a fit subject for history. Whether consciously or not, every society must have in it something of community; and so far as the members of it are members, so far as they are each incomplete parts, but taken together for the whole, so far it appears to me their past life is the proper subject of history." The history or life of a nation may be either rendered in parts, or as a whole. The most complete work is that which starts at the birth of a kingdom, or nation, and carries the reader upwards in its course amid its various ramifications, changes, and aspects, and finally leaves him when he has obtained a thorough insight into its life, past, present, and possibly future state. For instance, a complete history of France would have to commence with Roman Gaul, and would have to trace the life of England, and all contemporary kingdoms, at the same time as it gave the history of France *per se*, in order to enable the student to get a comprehensive glance at the extension of the kingdom, and the different influences which bore on it during its life and existence. A true historian must not merely satisfy himself in chronicling facts, for such a course would only reduce history to the level of chronological annals. Truth must be his greatest object, and justice his guide. When studying monarchy, if liberal in politics, he should not let republicanism actuate him; all bias of party must be waived in writing history correctly. Our most ancient civil history is found in the Old Testament; but its objects are confined, as it is written more as a chronicle of the acts of the Jewish race, than a general description of other nations, who were also connected with them, in relations of amity or war. Herodotus is the father of ancient history, as he is often rightly called; and to him we are indebted for the first work really deserving that title. The poems of Homer are sometimes regarded as an early history of Greece; but as his works were not written down when composed at first, it would be impossible to consider Homer in a true historic light, as they have only been handed down to us by word of mouth, and are thus liable to error. Thucydides and Xenophon are the writers who have bequeathed us the deeds of the Grecian commonwealth. Livy is the historian of Rome; Justin the compiler of a brief attempt at general history. The works of Cicero, Sallust, Tacitus, and Cæsar, also illustrate one of the most important eras in Roman history. After the downfall of that empire, a long series of revolutions took place in the rule of the world, and Europe became parcelled out in various dynasties and powers, giving rise to an increasing need of historical commentation. Of English historians, the venerable Bede is one of the first, and his writings give us the clearest view of the Saxon period. After the revival of letters, history became one of the greatest of literary works, and as such it is esteemed and valued in the present day. To follow its course in modern times would be a work of impossibility within the limits of the present article. Philosophical history is that in which the mere narration of facts is considered as subordinate to the elucidation of general truths and influences; and, consequently, it often lapses into the broaching of a favourite theory. Of philosophical historians, Gibbon on the "Decline and Fall of the Roman Empire" may be considered as entitled to the chief place; and Lord Macaulay's "History of England" is another instance of how grandly history has risen since first considered in the light of a science, united with literary composition. Whatever be the subject, whatever the political bias of the author, the value of the history will be in proportion to the general depth, greatness, and nobility of the historian's own nature, as a whole.

Hoar Frost. (*See* Freezing)

Hobson's Choice, *hob'-sons*, a vulgar proverbial expression, denoting without an alternative. It is said to be derived from the name of a livery-stable keeper, who used to let horses and coaches to students at Oxford, and who obliged every customer, in his turn, to take that horse which stood nearest the door. The students were consequently either to take that horse or have none; whence the expression, they had "Hobson's choice."

Hocus-pocus, *ho'-kus po'-kus*, a common epithet applied either to a juggler, or to a conjurer's trick or cheat. Its origin is uncertain, but it is said by Dr. Tillotson to be derived from the words *hoc est corpus*, the form used for consecrating the sacramental wafer in the Roman Catholic church; whence jugglers began to use it as a pass-word. Another etymologist, however, derives it from the Welsh *hocced*, a cheat, and *pocus*, a bag, applicable to the machinery by which a juggler performs his tricks.

Hoe, *ho* (Ang.-Sax.), an implement of husbandry employed to remove weeds, to make furrows, and to raise the mould round the roots of plants, &c. There are several kinds of hoes: that most common consists of a flat iron blade, having a thin round crooked bar of the same material, about eight inches long, projecting from the middle of its upper edge, at an acute

angle with it. To the end of this bar an iron ring or tube is attached, into which a long wooden handle is fitted. This is termed the *draw-hoe*, because, when in use, it is drawn towards the operator, in contradistinction to the thrust or Dutch hoe, which consists of a blade of iron fixed to the end of a long handle in continuation of it; so called from its being thrust forward when in use. For the cultivation of crops on a large scale, another kind of hoe is employed, much larger, and drawn by a horse. It consists, like a plough, of a beam and two stilts or handles. To this beam, and to branches extending from it, the ends of iron hoes of the proper width to stir the entire surface between the rows are fixed: a small wheel is also attached, to keep them the proper depth in the ground. This implement can, of course, only be used for those crops which are sown in rows; as peas, beans, potatoes, &c. The system of horse-hoeing found a great promoter in Jethro Tull, a gentleman from Hungerford, in Berkshire, who, having observed the good effects of stirring and loosening the soil round plants, and of keeping it perfectly clear from weeds, imagined that tillage might be made to supersede manuring. In carrying out this idea, the horse-hoe was, of course, a great assistance; and although not so successful as he expected, the constant state of tillage in which the spaces between the rows were kept, greatly increased the produce of the land, more especially when combined with judicious ploughing and manuring.

HOE'S PRINTING-MACHINE. (*See* PRINTING.)

HOG, or HOG FAMILY, *hog* (Welsh *hwch*, Cornish *hoch*) (*Suidæ*), a fam. of pachydermatous animals, belonging to the ord. *Ungulata*, of mammalia; or forming, according to some arrangements, a sub-family of the *Elephantidæ*, under the title *Suina*. The *Suidæ* are distinguished by having the nose prolonged and cartilaginous, truncate at the tip, where it is strengthened by small button-shaped bones, by which means they are enabled to use their noses as grubbers to turn up the ground in search of food. With the exception of the genus *Dicotyles* (*see* PECCARY), they have four toes on each foot, two large principal ones shod with stout hoofs, and two lateral ones, which are much shorter, and barely touch the ground. The canine teeth are large, often projecting from the mouth, and curved in an upward direction, while the molars are tubercular. Their skin is covered with thick, strong bristles, and they have a distinct tail of moderate length. The genus *Sus* is the type of the family *Suidæ*, and contains two well-known varieties,—the wild boar (*Sus scrofa*) and the domestic sow. Although formerly very common, the wild boar no longer exists in Great Britain; it is now found principally in India, and in most parts of Europe, where it harbours in the most solitary places in retired forests. As a beast of chase, it is thought well worthy of attention by sportsmen; and in India hog-hunting, under the technical term of "pig-sticking," forms one of the most exciting of wild sports. The food of the hog, in a wild state, is generally composed of grass, roots, acorns, beech-nuts, and wild fruits. He is both extremely active and very ferocious, and when driven to bay, forms a powerful adversary to even the most intrepid of hunters. In its domestic state the hog feeds and thrives on nearly every kind of food, both vegetable and animal; and no other species of beast converts a given quantity of corn or other nutritive food into fat so soon, or can be made fat on so great a variety of food. Of this useful animal there are many varieties; but the brindled hog approaches more nearly to the wild species than any other. The Chinese variety is very short in the head, corpulent in the body, and short in the legs: although good for roasting when about three weeks old, they only make tolerable porkers, and are not of much service in making bacon, as their size is but small. The Neapolitan hog is black and very plump, with erect ears and without any hair, and forms a very good cross with the Berkshire hog. The hog is very prolific, the sow often having ten or twelve pigs at a litter, and two litters in the year. Its flesh, under the name of *pork*, constitutes a material part of the food of mankind, especially in Europe and America, although Linnæus recommends that it should only be eaten by those of a strong athletic temperament, who take a good deal of exercise. The Jews and Mahommedans abstain from the flesh of the swine, and even consider themselves defiled by touching it. To a naval and commercial nation, like Great Britain, pork is of great importance, as it takes salt better than any other flesh, and is consequently able to be longer preserved. The fat is called *lard*, and is used both for culinary and medicinal purposes. The best English hogs are those from Hants and Berks. The skin, when dried, is used for making the seats of saddles, and other purposes. The bristles are used by brushmakers, shoemakers, and other artificers; and a great quantity is imported of the same from Russia; those from Ukraine being held in the highest estimation. (For a description of the manner in which the flesh of the hog is cured, *see* arts. BACON and HAM.) The Abyssinian hog (*Babirussa Alfurus*) is an inhabitant of the islands of the Indian Archipelago: it differs from the common hog, or *sus*, in consequence of the upper canine teeth being enormously developed, ascending upwards and curving back, while those of the lower jaw project straight outwards, and form long slender hooks. The Ethiopian hog (*Phacochœrus æthiopicus*) is another variety; its only great distinction is the possession of a pair of lobes under the eyes, which give it a peculiar appearance; and, although much more muscular, in other respects it generally resembles the common type of the *Suidæ*. It inhabits Central Africa, and its flesh is esteemed a great dainty. Fossil remains of most of the members of the hog family have been found in tertiary formations, three alone of the species being found in the Eppelsheim Sands, while their bones have been discovered in nearly every country.

HOG-GUM. (*See* RHUS.)

HOG-NUT. (*See* CARYA.)

HOG-PLUMS. (*See* SPONDIAS.)

HOGSHEAD, *hogz'-hed*, a term formerly employed to denote a measure of capacity; but as all excise measurements are now made in gallons, it is used to designate any large cask. The hogshead, in wine measure, contained 63 gallons, while in beer and ale measure, there were only 54 gallons.

HOLCUS, *hol'-kus*, in Bot., a gen. of the nat. ord. *Gramineæ*, the species of which are natives of Africa and Asia. *H. saccharatus* (the *Sorghum saccharatum* of some botanists) is called the North China sugarcane, or sweet sorgho, and is much cultivated in China and other parts for the sake of its sugar; it is said to yield from 10 to 15 per cent. of this product. Its grain is eaten in Africa, and is termed *dochna*. The plant has lately been introduced into Britain, and is highly recommended by some agriculturists for cultivation as a summer forage for cattle. *H. Sorghum* (*Sorghum vulgare*, or *Andropogon Sorghum*) is extensively cultivated in many parts of Africa, in Turkey, and in India, for the sake of its grain, which is known by the names of Guinea corn, durra, Turkish millet, and jaar. This grain is much used as human food in warm countries; in Britain it is occasionally employed for feeding poultry. A kind of beer, called *bouza*, is prepared from it. The stalks of the plant are used to make whisks and carpet-brooms.

HOLD, *holde*, in Mar. is a term applied to the whole of that portion of a ship which is comprehended between the floor and the lower deck. It is usually divided into several store-rooms by bulkheads. In ships of war, the hold contains the ballast, provisions, and stores; and in merchantmen, the whole or principal part of their cargo.

HOLIGARNA, *ho-le-gar'-na*, in Bot., a gen. of the nat. ord. *Anacardiaceæ*. The fruits of the species *H. longifolia*, with those of another plant of the same order, furnish the black varnish of Sylhet, which is much used in India for lacquer-work. (*See* SEMICARPUS.)

HOLINESS, *ho'-le-ness*, a title by which the ancient Greek emperors were addressed, but which is at present only applied to the Pope, as head of the Roman church. The term itself is equivalent to the Latin "Sanctissimo," which is more commonly used.

HOLLAND. (*See* LINEN MANUFACTURE.)

HOLLY. (*See* ILEX.)

HOLLYHOCK. (*See* ALTHÆA.)

HOLOCAUST, *hol'-o-kawst* (Gr. *holos*, the whole, and *kaio*, I burn), a solemn burnt-sacrifice, common

amongst the Greeks and other pagan nations of antiquity, in which the *whole of* the victim was consumed upon the altar, in contradistinction to the usual custom, which enjoined that only a portion of the sacrifice should be consumed. The Jews held to a similar custom, marked out to them by the ceremonial law of Moses, which sacrifice was termed, in scriptural language, a *burnt-offering*.

HOLOPTYCHIUS, *ho-lop-til'-ke-us* (Gr. *holos*, entire; *ptuche*, wrinkle—literally, "all-wrinkle"), in Geol., a gen. of sauroid fishes, belonging to the Devonian and Carboniferous periods. Their enamelled scales have corrugated or wrinkled surfaces, and this character suggested the generic name. The *Holoptychii*, judging from their fragmentary remains, must have been of great size—from 8 to 10, or even 12 feet in length. They were armed with numerous sharp-pointed fish-teeth, and also with larger reptilian teeth of conical form, placed at intervals in either jaw, evidently for the purpose of seizing and cutting up their bulkier prey.

HOLY ALLIANCE, *ho'-le* (Sax. *halig*), the name given to a league formed by three of the principal sovereigns of Europe, with the exception of England, after the defeat of Napoleon at Waterloo, on the proposal, it is said, of the emperor of Russia. The Germans, who suffered more by the aggressions of Napoleon than any other nation in Europe, took refuge in religion, and thinking that it might be made the basis of an international treaty, readily agreed to the terms of the Holy Alliance. Alexander is said to have written the act in his own handwriting, and sent it to the emperor of Austria and the king of Prussia, to have it confirmed and accepted by them. The Holy Alliance was published by the emperor Alexander in the year 1816, and by the other powers shortly after. The original terms were, to say the least, indefinite, and did not embrace more than the preservation of peace, justice, and religion in the name of the gospel. It was afterwards determined by the heads of the governments of Russia, Austria, and Prussia, to admit other nations within the statutes of the alliance; and, subsequently, England and France joined it by the Declaration of November, 1819. After the Franco-Spanish war in 1823, the Holy Alliance gradually languished, through not fulfilling its purposes; and the French revolution, and other events in 1848, succeeded finally in destroying it; as ever since it has had only a passive existence.

HOLY GHOST. (*See* TRINITY.)

HOLYSTONE is a soft stone made use of for scouring ships' decks.

HOLY ORDERS. (*See* ORDINATION.)

HOLY THURSDAY, the day on which the ascension of our Saviour is commemorated,—ten days before Whitsuntide. It has been kept in the Christian church from the earliest ages. St. Augustine speaks of it as then instituted by the Apostles or by some early council of the primitive bishops. It is now greatly neglected in our church, for what reason it is difficult to account, except it be because it is not marked by any worldly festivities, that many neglect and pass it by. (*See* ASCENSION-DAY.)

HOLY WATER, in Greek and Roman Catholic churches, water which has been blessed, or consecrated, by an appropriate service, and used to sprinkle the worshippers and the things used in the church. It is kept in a shallow basin, called the "holy-water stoup," placed at the entrance of the church. It was formerly used to wash the hands of the devotees, to purify them before commencing their devotions. Some Catholics keep holy water in their chambers to use before prayer, especially at bed-time. In Rome and Moscow, animals are sprinkled with it to keep them healthy and thriving; indeed, in the latter city, there is a particular church to which horses are taken annually for this purpose. According to some writers, vessels were not placed at the church doors for washing the hands until the 4th century, and the water was not blessed for this purpose until the 6th, while others say it was employed by the Apostles.

HOLY WEEK, commonly called Passion Week, because in that week our Saviour's *passion* and death took place. It is the last week in Lent, and immediately precedes Easter. By the primitive Christians it was called *Hebdomas magna*, or the great week, and it was kept by them with great reverence, by additional devotions, longer fastings, more liberal alms, vacation from all civil business, and a general release of prisoners, except some particular cases of criminals. (*See* PASSION WEEK.)

HOMAGE, *hom'-ij* (Fr. *hommage*, from Lat. *homo*, man), an incident of feudal tenure, by which a tenant promised submission, loyalty, and service to his lord or superior when first admitted to the land which he held of him in fee. According to Sir Edward Coke, the word is derived from the Latin *homo*, 'a man;' because when the tenant did his service to his lord, he said, "I become your man," &c. The oath of *fealty*, or declaration of fidelity, was first taken, and then the vassal or tenant did homage to his lord, humbly kneeling, being ungirt, uncovered, and holding up his hands both together between those of his lord, who sat before him. In modern language, the term homage is generally applied to reverential worship or devout affection.

HOMALIACEÆ, *ho'-mă-le-ai'-se-e*, in Bot., the *Homalium* fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciflora*, comprising eight genera and thirty species, natives of the tropical parts of India, Africa, and America. They are trees or shrubs, with alternate leaves; the calyx is superior and funnel-shaped, with from 5—15 divisions. The petals are equal in number to, and alternate with, the divisions of the calyx. The stamens are opposite to the petals, and inserted on them; they are either distinct, or in bundles of three or six. The ovary is 1-celled, with parietal placentas, numerous pendulous ovules, and from 3—5 styles. The fruit is a capsule, or berry, with small seeds, having the embryo in the axis of a little fleshy albumen. Some species of the typical genus *Homalium* are remarkable for their astringent properties.

HOME SICKNESS. (*See* NOSTALGIA.)

HOMICIDE, *hom'-e-side* (Lat. *homicidium*), the killing of any human being. Homicide is of three kinds,—*justifiable*, *excusable*, and *felonious*. The first has no stain of guilt; the second very little; but the third is the highest crime that man is capable of committing against a fellow-creature. Justifiable homicide is of various kinds, including such as arise from unavoidable necessity or accident, without any imputation of blame or negligence in the person killing. Homicide in the course of justice, in the execution of any criminal or civil process, is of this kind. The necessity must, however, be real and apparent in all cases of this sort. Homicide is justifiable in the prevention of any atrocious crime, as an attempt to murder, or to break into a house during the night. Justifiable homicide does not apply to crimes which are unaccompanied by violence; such as the picking of pockets. The general principle of the law is, that when a crime in itself *capital* is endeavoured to be committed by force, it is lawful to repel that force by the death of the party attempting it. Excusable homicide is committed either by misadventure or in self-defence. Homicide by misadventure is where a man doing a lawful act, without any intention of hurt, and using proper precaution to prevent danger, unfortunately kills another; as when a man is at work with a hatchet, the head flies off and kills a bystander; for the act is lawful, and the effect is merely accidental. As prize-fighting and sword-playing are unlawful, if either of the parties engaged be killed, such killing is felony or manslaughter. Homicide in self-defence, from a sudden affray or quarrel, is rather excusable than justifiable in the English law. Felonious homicide is an act of a very different character from the two former, being the killing of a human creature, of any age or sex, without justification or excuse. It is divided into three classes,—murder, manslaughter, and self-destruction.

HOMILY, *hom'-e-le* (Gr. *homilia*, an assembly), a plain and familiar discourse on some point of religious faith or duty. The term homily was introduced into the Church in order to distinguish the practical nature of Christian discourses from the speculative and ostentatious harangues of the schools of philosophy. In the early days of the Church, only the bishops were allowed to preach; consequently, the homilies of the Greek and Latin fathers are all written by bishops. The privilege of writing homilies was not accorded to priests till the 5th century. St. Chrysostom was the first presbyter

who preached regularly, although St. Augustine a Origen preached, but only by a peculiar privilege or license. The difference between a homily and a sermon is thus distinguished by Photius:—"The homily was then delivered in a more homely manner, the prelate interrogating and talking to the people, and they, in their turn, interrogating and answering him." So that, originally, a homily was, correctly speaking, a conversation; whilst the sermon was spoken continuously from the pulpit, after the manner of the orators. Towards the close of the 8th century the practice of compiling homilies, which were committed to memory, and recited by ignorant or indolent priests, began to be prevalent. Charlemagne then ordered Paulus Diaconus and Alcuin to form homilies upon the Gospels and Epistles from the ancient doctors of the Church. The *Homilarium* of Charlemagne was afterwards published, which acted as a model for the famous collection of homilies subsequently produced. Many of these productions were the work of private persons, and contributed much to nourish the indolence and perpetuate the ignorance of a worthless clergy. The book of homilies recognized by the English church is a collection of homely sermons on the doctrines of the gospel, with an especial view to illustrate the principles of the Reformation. The first portion of this work was published by Cranmer in the reign of Edward VI.; and during the reign of Elizabeth the second part was added by order of Convocation.

HOMŒOPATHY, *ho-me-op'-ă-the* (Gr. *homoios*, like, and *pathos*, state or feeling), is the name given to a system of medical treatment introduced by Samuel Hahnemann, a German physician, in 1796, and now extensively practised, and having many adherents. Hahnemann had observed that Peruvian bark, which acts as a specific in agues, produced upon the healthy subject exactly the same symptoms as those of the disease which it served to cure. Continuing his observations, he fancied that he had obtained a number of other instances to the same effect; and at length he came to the conclusion, that diseases are cured by such substances as produce symptoms similar to them on the healthy body: hence the great doctrine of this sect is, "Similia similibus curantur" (like are cured by like). The others they term allopathists (Gr. *allos*, other, and *pathos*, state), and assert their doctrine to be, "Contraria contrariis curantur" (contraries are cured by contraries). The general law, that like is cured by like, by no means originated with Hahnemann, but is as old as the time of Hippocrates, by whom it was first propounded. No one, however, previous to Hahnemann, had ever asserted it to be of universal application. Nothing is better suited for restoring circulation to a frozen limb than to rub it with snow; and the best mode of treating a burn is to take out the heat by holding it to the fire, or by applying oil of turpentine. The benefits that arise from vaccination are also owing to the same principle. Another characteristic feature of this system is the infinitesimally small doses in which their medicines are usually administered. In the case of a medicine where an ordinary medical man would prescribe perhaps a grain, the homœopathist would administer only the millionth part of a grain, or even less. They assert that only very minute doses are fitted to act upon a system already predisposed to their influence by the existence of the disease; and hence the amount of the medicine must be diminished so as to exert its curative power upon the system without aggravating the symptoms of the disorder. This system has been adopted by not a few medical men of distinction, and its adherents are to be found in most parts of the civilised world. There is reason to believe that the system is now on the decline, owing probably to the introduction of more liberal views among medical men generally. It is worthy of remark, that not a few homœopathists practise both systems; and their patients may be treated homœopathically or allopathically, as they prefer.

HOMOGENEOUS BODIES, *ho-mo-je'-ne-ous* (Gr. *homos*, the same; *genos*, kind), those bodies in which the constituent elements are all similar. In Math., homogeneous quantities are those which can be added to or subtracted from one another.

HOMOLOGOUS SERIES, *ho-mol'-o-gus* (Gr. *homos*, similar; *logos*, proportion), a series whose numbers differ from each other by a constant increment or decrement of an even number of equivalents of CH. They are generally classed under a generic term, such as the alcohols, hydrocarbons, &c. The following series of homologues will illustrate this:—

Hydrocarbons.		*Alcohols.*	
C_2H_2	Methylene.	$C_2H_4O_2$	Methylic alcohol.
C_4H_4	Ethylene.	$C_4H_6O_2$	Ethylic „
C_6H_6	Tritylene.	$C_6H_8O_2$	Tritylic „
C_8H_8	Tetrylene.	$C_8H_{10}O_2$	Tetrylic „
$C_{10}H_{10}$	Amylene.	$C_{10}H_{12}O_2$	Amylic „

By examination it will be seen that each of the members of these series differs by exactly C_2H_2. The ethers, aldehyds, mercaptans, and many others, form similar homologous series. The corresponding difference in composition produces a corresponding difference in properties. Thus, the boiling-point of the alcohols rises exactly 33° Fah. for each increment of C_2H_2 in the alcohol. *Heterologous series* are those which differ in properties, but are related in composition. Thus methyl, methylic ether, and methylic alcohol, form a heterologous series differing entirely in their properties; and methyl, ethyl, and trityl, form a homologous series closely related in their properties. (*See* SERIES.)

HONE, *hone* (Sax. *han*, a stone), a term for the finer kind of whetstones. They are mostly talcose slate of very close texture, in which the particles of silica are very finely divided and evenly distributed. *Turkey oil-stones*, said to be the best of all the hones, are obtained from the interior of Asia Minor; the *German razor-hones* from the slate-hills near Ratisbon; the *Arkansas oil-stones* from North America. The *Charnley Forest* stones are next in repute to the Turkey stones.

HONEY, *hun'-e* (Sax. *hunig*), a fluid, or semi-fluid substance, very similar in its properties to sugar. It is found in large quantities in a number of vegetables, and is collected by different kinds of bees from the nectiferous glands in the cup or chalice of flowers. Honey, in the ordinary sense of the word, however, cannot be called a purely vegetable production; for, after it is collected by the proboscis of the insect, it is transmitted to the sucking-stomach, or honey-bag, where it is elaborated, and afterwards disgorged, to be deposited in the cell of the honeycomb. When the bees are very young, the honey undergoes less change and remains nearly white; in this state it is called virgin honey. At all times it partakes of the qualities of the plant from which it has been derived. Hence, some varieties of honey obtained from the azalea, rhododendron, &c., are poisonous. The most wholesome kinds are derived from the genus *Erica*, called heather honey, and from most labiate plants. Honey differs much in colour and consistence; it contains a considerable quantity of saccharine matter, and some mucilage, from which it derives its softness and viscosity. It ferments very readily, and yields a strong vinous liquor called *mead*. There are two varieties of honey,—one yellow, transparent, and of the consistence of turpentine; the other white, and capable of assuming the solid form, and of concreting into regular spheres. These two species are often united, and may be separated by means of alcohol, which dissolves the liquid honey much more rapidly than the solid. Honey is the production of most countries, but is more particularly abundant in the island of Candia, and in the greater part of the islands of the Archipelago. The honey of Sicily appears to be particularly high-flavoured, and in some parts of the island to surpass even that of Minorca, owing, no doubt, to the quantity of aromatic plants which overspread that part of the country. This honey is gathered three times in the year,—in July, August, and October. It is found by the peasants in the hollows of trees and rocks. The country of the lesser Hybla is now, as of old, chiefly celebrated for its honey. In the woods of North America, considerable quantities of honey are produced by the wild bees. Honey is much used in making preserves and confectionery; and, in its natural state, to put on bread. It is also used as a demulcent medicine against hoarseness, catarrh, &c.; and externally to promote suppuration. In its clari-

-fied state, it is used to sweeten certain medicines. It is more aperient and detergent than sugar, and is particularly serviceable in promoting expectoration in disorders of the breast. For these and other like purposes, it is often mixed with vinegar, and boiled down to a proper consistence over a slow fire, when it forms the oxymel of commerce. Honey was one of the first articles of human nourishment. The deities of ancient Greece were supposed to live on milk and honey. Aristotle, and several other learned writers, and probably the ancients generally, did not know where honey originally came from; they imagined that it fell from heaven like rain. Pliny was unable to decide whether it descended from the heavens generally or from the stars, or was a juice formed by the purification of the air, and afterwards collected by bees. In all the works of the ancients, much importance is attached to honey and the care of bees. Honeycomb or the waxen structure framed by bees, in which they deposit their honey and eggs, is one of the most surprising of all the works of insects. By the peculiar organisation of the bee, the wax is secreted in the form of small and thin oval scales in the folds of the abdomen. The materials, however, of which it is composed, though collected from the flowers of plants, are unknown, and have given cause for much speculation. The regular structure of the honeycomb is also remarkable. It is composed of a number of cells, most of which are exactly hexagonal, constructed with geometrical accuracy, and arranged in two layers, placed end to end, the openings of the different layers being in opposite directions. As the comb is placed vertically, the cells are horizontal. The construction of the cells is such as to afford the greatest possible number in a given space, with an expenditure of the least possible amount of material. The base of each cell is composed of three rhomboidal pieces, placed so as to form a pyramidal concavity. The sides of the cells are also much thinner than the finest paper; and yet they are so disposed as to be strong enough to resist all the motions of the bee within them. (*See* BEE.)

HONEYSUCKLE. (*See* LONICERA.)

HONG, *hong*, the name given by the Chinese to any factory belonging to European merchants at Canton. The Hong merchants were ten or twelve natives who were the only ones legally entitled to trade with foreigners, or "the outer barbarians." Since the last Chinese war, however, the facilities for trade have been greatly increased, and commerce, instead of being monopolized by the Hong merchants, has become more general.

HONOUR, *on'-or* (Lat. *honor*), a term which, in its ordinary sense, is capable of many and various significations, all of which, however, may be easily traced back to the original meaning of the word; viz.—*a certain esteem or regard built on opinion.* The Romans had such a high opinion of honour, that they actually deified the word; and in modern times it plays a part hardly inferior to that which it did in the days of antiquity. It is used in various terms of phraseology to mark out, or indicate, certain rules or notions by which society in general, and especially that more powerful portion of it denominated "the fashionable world," regulates its proceedings with a sort of tacit understanding; any deviation from which rigorous code incurs the risk of expulsion beyond its pale. The phrases *debt of honour*, *affair of honour*, *law of honour*, *court of honour*, with some slight modifications, emanate from the above meaning, and thus carry their own interpretation along with them. The title "your honour" was formerly applied to men of rank generally, but it is now limited to, and distinctly conferred on, the Vice-Chancellor and the Master of the Rolls.

HONOUR, LEGION OF. (*See* LEGION OF HONOUR.)

HONOUR, MAIDS OF, in the courts of European sovereigns, are ladies whose duty it is to attend the queen when she appears in public. In England they are eight in number, with a salary of £300 per annum each.

HONOURS OF WAR, in Mil., are certain stipulated terms granted to a beaten enemy, by which he is permitted out of a fortress or town, or from a camp or a line of intrenchments, with all the pomp and pageantry of military etiquette. The term is also used to signify the compliments offered to high personages or military heroes when they appear before a body of armed men, or such as are given to the remains of a deceased officer.

HOODED SNAKE, *hood'-ed*, in Nat. Hist., the Cobra di capello (Port., snake with the hood). This term is sometimes applied to the *Naja tripudians* alone, and sometimes to all the species of the genus *Naja*, which are very venomous serpents of the *Viperidæ*. They are all remarkable for the singular manner in which they dilate the back and sides of the neck when irritated or excited. To this faculty they are indebted for their name; since the elevated skin of the back of the neck, when viewed in front, presents much the appearance of a hood. Its length is generally three or four feet, of a pale dingy brown colour above, and bluish or yellowish-white below. It is characterized by a peculiar mark on the back of the neck, which closely resembles a pair of spectacles: for this reason the reptile is frequently called the "spectacle snake." It lives upon lizards and other small animals, and is easily killed, being a sluggish animal. Its bite is extremely venomous, causing death within two hours. The hooded snake is often found in the neighbourhood of human dwellings in the East Indies, and is sometimes found in the houses themselves. It appears to be attracted by the young poultry and the moisture of the drainage and wells. The poison of the hooded snake is secreted in a large gland in the head; and when the animal closes its mouth on any object, the poison flows into the wound made through a cavity in the tooth; it is, however, little disposed to use its fangs, except for the purpose of supplying itself with food. The Indian jugglers tame some of these serpents, and teach them to play tricks and dance, to astonish the people,—after having taken care, however, to pull out their poisonous teeth. The same use is made of another species in Egypt.

HOOKAH. (*See* PIPES.)

HOOPING-COUGH, *hoop'-ing* (Ang.-Sax.), in Med., a cough in which the patient hoops or whoops with a deep inspiration of breath. On account of the violence of the cough attending this disease, the term *pertussis* has been applied to it; and on account of the recurrence of the cough in paroxysms, it is also known by the name of "chin," or "kink" cough. Hooping-cough seems to have been unknown to the ancients, as no mention of it is made in the medical works of the Greeks, Romans, and Arabians. It has, however, prevailed for several centuries in various countries of Europe, and on account of its frequent occurrence, and the danger with which it is often accompanied, it has occupied the attention of physicians considerably. The symptoms commence with a simple catarrh, indicated by a cough, and the expectoration of a limpid fluid; by redness of the conjunctivæ, a watery discharge from the eyes and nostrils; hoarseness, and occasional sneezing. These symptoms are generally accompanied by slight feverishness, and the patient is low-spirited and languid. Thus far the disease closely resembles a common cold; but at the end of about one or two weeks, the character of the affection changes. The fits of coughing become more long and frequent; a sensation of tickling in the larynx and trachea accompanies each fit, during which the inspirations are irregular, especially in the case of children, whose faces bear an expression of anxiety and fear. When the fit comes on, they cling firmly to the persons or objects near, and, if asleep, start up. The efforts of coughing then become so rapid and violent, as to take away the breath; during the intervals between, it is difficult to perceive any inspiratory movements, excepting at times when the cough is interrupted by a peculiar whooping sound, which has given this disease its common name. In young children, hooping-cough often becomes complicated with other diseases. The most common complication with children at the breast is cerebral congestion, giving rise to convulsions. Hooping-cough prevails as an epidemic disease, and children from birth to the period of second dentition, are chiefly liable to it. Adult persons, however, are not exempt from it, and it sometimes happens in old age. The disease is very contagious, and when it once finds admission into a house, very few young persons, who have not had it

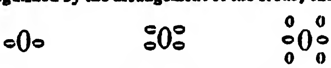
previously, escape. It rarely affects the same individual twice, although this sometimes occurs. Hooping-cough is a very fatal malady; the average number of deaths in London every year, for the ten years between 1849 and 1859, was 2,190. Hitherto, no treatment of hooping-cough has been discovered, by which its progress can be arrested; its severity, however, can be mitigated and its duration diminished. It must, necessarily, run a certain course, which often, in spite of skilful treatment, may be long. The administration of emetics in the earliest stages of the disease is often efficacious; and tartar emetic, on account of its easy solubility and certain action, seems to be best suited for the purpose. In protracted cases, nothing appears to be so effective in putting a stop to the cough as change of air, which frequently succeeds when all other methods have failed. The diet should always be of the mildest description at the commencement, but afterwards it is advantageous to adopt a more tonic and nourishing regimen.

HOOPOE, *hoop'-o* (*Upupa epops*), an insessoral bird belonging to the family of the *Certhiadæ*. Its generic characters are: beak longer than the head, slightly bent, slender, triangular, and greater in length than in breadth; nostrils basal, lateral, oval, and partly concealed by the feathers on the forehead; wings of moderate size, the fourth and fifth quill-feathers being the longest; tail of 10 feathers, square at the end; toes 3 in front, 1 behind, the outer and middle ones being united as far as the first joint; claws short, and only slightly curved. The hoopoe is a summer visitor to the British islands, and comes from the north of Africa; it is also a native of Asia. This bird is generally about a foot in length, and its plumage is composed principally of black and white feathers; it is particularly distinguished by a crest on the top of its head, composed of buff feathers, tipped with black. *Ref* Yarrell's *British Birds*.

HOPS. (*See* HUMULUS.)

HORARY, *hor'-à-re* (Lat. *hora*, an hour), in Astron., the arc described by the sun, moon, or any of the planets, in the space of an hour, or the angle which is subtended by that arc is called its horary motion.

HORDEUM, *hor'-de-um* (Lat.), Barley, a gen. of the nat. ord. *Gramineæ*. The principal species or varieties of cereal barley in cultivation are practically distinguished by the arrangement of the seeds; thus:—



Two-rowed. *Four-rowed.* *Six-rowed.*

The two-rowed forms, which are generally regarded as varieties of the species *H. distichum*, are those ordinarily cultivated in England. The six-rowed barley, *H. hexastichum*, is more grown in Scotland, where it is known as *bere* or *bigg*. The four-rowed is perhaps only a variety of the six-rowed, though it is described as a distinct species, generally under the name of *H. vulgare*. Very various have been the opinions as to the wild species from which the cultivated barley has sprung; but as *H. distichum* is the only kind that has ever been found apparently wild, it is probable that all the varieties in cultivation have been derived from this type. Barley is used dietetically in the manufacture of bread; and in the form of *malt* (which *see*), most extensively in the production of ale, beer, and ardent spirits. It is the common grain in use for the latter purpose in this country. Barley deprived of its husk constitutes *Scotch*, *hulled*, or *pot barley*. When both husk and integuments are removed, and the seeds rounded and polished, they form *pearl barley*, and this, when ground, is called *patent barley*.

HOREHOUND. (*See* MARRUBIUM.)

HORIZON, *hor-i'-zon* (Gr. *horizein*, to bound, limit).—The horizon, in the general acceptation of the word, is the line by which the view of the spectator is bounded, and in which the sea or land and sky appear to meet. When he is on a level plain of great extent, or at sea, the horizon will assume the form of a circle. This is termed the physical or natural horizon. In this case its extent is limited by a circle traced out by the revolution of a point about the position of the spectator as a centre, at which point a line drawn from his eye forms a tangent to any great circle described on the earth's surface, and passing through the spot on which he is standing. It should, however, be stated that the effect of the refraction of light causes the actual limit of vision to be extended a little beyond the circle that would be traced in the manner indicated above. The higher the position of the observer, the greater will be the field of view, or the more distant the horizon will appear; thus a man at the masthead of a vessel can see what is invisible to those who are on deck. To find the distance of the horizon at sea approximately, first ascertain the height of the observer above the sea-level in feet, extract the square root of this quantity, and add to the result three-tenths of the same; the amount thus obtained will give the distance of the horizon pretty closely in miles. The astronomical horizon theoretically is formed by a plane passing through the centre of the earth at right angles to another passing through the meridian of the heavens into two parts, and constantly changes as the spectator varies his position on the earth's surface. Thus, if he were at the north pole, he would see the stars in the northern hemisphere; at the south pole, the stars in the southern hemisphere; while at the equator he would see a hemisphere of the heavens, embracing part of the stars in the northern hemisphere and part of those in the southern. The distance between the earth and the fixed stars is so great, and the radius of the earth so insignificant in proportion to it, that the physical horizon, as it appears to a spectator on the earth's surface, and the astronomical horizon in which he is supposed to be at its centre, may be considered as coincident for all practical purposes. Observations on land are frequently taken by the aid of what is termed an artificial horizon, which consists of the level surface of a trough of mercury, which is parallel to the plane of the horizon, and in which the image of the heavenly body is reflected.

HORN, HORN MANUFACTURE, *horn* (Sax.).—The term horn is, in general language, applied to a hard substance growing on the heads of certain animals, and particularly on cloven-footed quadrupeds, usually attaining some length and ending in a point. They serve as weapons of offence and defence to the animals which bear them. In England, the substance called horn may be divided into two distinct classes:—First, the branched, bony horns of the stag genus, and the simple, laminated horns of the ox genus and other kindred genera. The first of these kinds of horn is applied to the same purposes as bone and ivory, and the manufacture is almost similar. The other kind of horn, found in the ox, antelope, goat, and sheep, consists of a number of conical sheaths inserted one into another, the innermost resting upon the vascular membrane covering the bony core. The tip is very dense, and the layers of which it is composed are scarcely distinguishable. This kind of horn appears to consist of coagulated albumen; and there is a regular connection between horns, nails, claws, hoofs, scales, hair, feathers, and even skin. The horns of oxen are the principal ones used for manufacturing purposes; the horns of bulls and cows being preferred to those of bullocks, which are thin and of a coarse texture. The horns of goats and sheep are whiter and more transparent than those of any other animals. In horn-manufacture, the first process necessary is to remove the core. This is effected by steeping the horn in water for about a month, when the horny sheath becomes so softened that the core can be readily withdrawn. The cores are not wasted, but are afterwards burnt, forming bone-ash, a substance valuable in making cupels for assaying purposes. They are also used in other ways,—for making glue, stiffening for cloth-dressers, and for manure. The solid tip of the horn, after being sawn off, is used for making knife-handles, umbrella-handles, &c. After being divided into thin laminæ, the remainder of the horn is used for various purposes. The lower part is frequently used for making combs, while the middle is used for making lanterns, &c. To prepare the horn for use, it is softened by means of boiling water, and then usually held in the flame of a fire till it gains the temperature

of melting lead, and becomes so soft as to be fluid. While in this state, the slitting is performed by means of a pointed knife resembling a pruning-knife then, by means of two pairs of pincers, the cylinder or cone of horn is opened till it is nearly flat. A number of pieces are then exposed to pressure between plates of iron previously heated and greased. The degree of the pressure depends upon the required use of the horn. The thin sheets of horn are then scraped with a blunt or wire-edged draw-knife upon a board covered with hide. After being smoothed and brought to the required thinness, they are polished with a woollen rag dipped in charcoal-dust, a little water being added at times. After being rubbed with rotten-stone, they are finally polished with horn shavings. When horn is to be converted into combs, the pressure required to be as slight as possible, lest, by the breaking of the grain, the teeth become liable to split. Horns for combs are roughly cut by a hatchet or saw to the required shape, and then finished by rasping and scraping. Ornamental horn combs, with open work, are largely manufactured in France. Snuff-boxes, combs, and other ornamental articles, are often made by pressing horn shavings, after reducing them to a soft state by means of heat. Drinking-horns, are made by sawing the horn to the required length, scalding and roasting it over a fire, placing it in a conical wooden mould, and bringing it into the required shape by driving a wooden plug firmly into the interior. It is afterwards fixed on a lathe, when cold and hard, and turned and polished both on the inside and outside. The bottom, a round flat piece of horn, is dropped in at the larger end of the cone of horn, while the latter is warm. At the smaller end of the vessel is a groove into which the bottom slips, and as the horn contracts in cooling, so the bottom becomes firmly fixed, and the drinking-horn water-tight. The process of dyeing horn of different colours is very easy. It is usually coloured of a rich reddish brown in this country, and spotted so as to imitate tortoise-shell. The whole of the refuse of horn manufacture is valuable. Hoofs and horn-cuttings are used for making prussiate of potash and Prussian blue; and the clippings of the combmaker are used as manure. An artificial horn is made from the gelatine obtained from bones by muriatic acid, and converting it into a horny substance by tanning. Large quantities of horn are imported into this country. In Sheffield alone nearly 300,000 deer-horns are required annually for making handles for cutlery. The imports of foreign horn average about 4,000 tons per annum.

HORN, a wind instrument, of which there are various kinds, made of different materials; such as wood, brass, copper, and sometimes silver. (For a description of the horn, *see* FRENCH HORN, BUGLE, CORNET-A-PISTON, SAX-HORN, &c.)

HORNBEAM. (*See* CARPINUS.)

HORNBILL, *horn'-bill* (*Buceros*, from Gr. *bous*, an ox, and *keras*, a horn), a gen. of birds belonging to the conirostral tribe of the ord. *Passeres*. These birds characterised by having their large hooked beak surmounted at the base by a horny appendage nearly as big as the beak itself, and of a cellular structure within. They live on animals and vegetables, and inhabit the warmest parts of Asia and Africa. On account of their perching on the branches of lofty trees, where their vision can command an extensive range, they are extremely difficult of approach. Like the toucans, they swallow their food whole, throwing it first up in the air and catching it as it falls. The rhinoceros hornbill (*Buceros rhinoceros*) is about the size of a turkey, and of a bluish-black colour. The horny appendage at the base of the bill of this variety is very large, and in the form of a reverted horn. It is a native of Java, and hops about on both legs like a raven, feeding chiefly on rats and mice. The African species (*Buceros africanus*) is considered a sacred bird by the negroes, who never destroy it on any account, from a superstitious belief that the death of a hornbill produces sickness over a whole district. The pied hornbill (*Buceros monoceros*) is about the size of a raven, and nearly as black. Its crest is thin, and frequently much injured by striking against the branches of trees, the bark of which the bird tries to detach, in order to get at the insects lying beneath. From its fondness for the same insects, this species is carefully reared in Ceylon, in order to keep the houses clear of vermin. The pied hornbill is a native of India, and lives in withered trees, in the holes of which it deposits its eggs. The undulated hornbill (*Buceros undulatus*) is the last variety, and the most beautiful specimen of the whole genus, as the bill is more proportionate to the size of the bird, and its plumage is distinguished by more than the usual vivid colours, which add to the magnificent appearance of oriental birds.—*Ref.* Baird's *Encyclopædia of the Natural Sciences*.

HORNBLENDE, *horn'-blend* (Ger.), in Min., a mixture of the silicate and aluminate of magnesia, lime, protoxide of iron, with a variable quantity of the fluorides of calcium and potassium. It occurs in dark green or black crystals, in syenite, porphyry, basalt, and lava. It is also known as amphibole, a name bestowed on it by Haüy. *Asbestos* and *amianthus* consist of a fibrous variety of hornblende.

HORNBOOK, *horn'-book*, a name formerly given to a copy of the alphabet set in a frame and covered with a thin plate of transparent horn, to prevent the paper from being thumbed to pieces by the children who were made to study it. The hornbook was generally used as a child's first step towards knowledge, but it has now become obsolete as an instrument of elementary education.

HORNET, *hor'-net* (Sax. *hyrnete*), (*Vespa crabro*), an aculeated hymenopterous insect, belonging to the *Vespidæ*, or Wasp family. The principal characteristic of the insect is taken from the structure of its wings; these, when it is at rest, are folded throughout their entire length. The fore wings have one marginal and three sub-marginal cells; and in all species the neuration is the same. The hornet is a much larger insect than the wasp, and is consequently much more formidable. It builds its nest in holes in the trunks of trees, or in old walls and ditches. Its colour is throughout of a dark brown mixed with yellow, and the head is oblong. It is very voracious and pugnacious, while the common wasp seems to be its favourite prey, although it eats almost any kind of flesh, as well as fruit and honey. The nest is smaller than those of the wasps, and is of a globular form, constructed with the mouths of the cells downwards. Hornets are the most active little insects; they fly rapidly, and have been observed to carry on the building of their nests by moonlight, unlike the habit of most insects. Their sting is very severe, and is often productive of serious consequences. (*See also* VESPIDÆ.)

HORNPIPE, *horn'-pipe*, a rustic musical instrument seldom or ever now seen, except in Wales, where it is still very common. Its Welsh name is pib-corn, meaning hornpipe; it is so called from its being constructed of a wooden pipe, with holes at certain distances and a horn at each end, one to collect the wind blown into it, and the other to augment the sound. This term is also applied to a dance in triple time of six crotchets in a bar.

HORN-WORK. (*See* CROWN-WORK.)

HOROLOGIUM, *hor-o-lo'-je-um* (Lat. *horologium*, a clock, timepiece), a constellation of the southern hemisphere, formed by Lacaille, situated between Canopus and Eridanus, and formed entirely of stars of the fifth and sixth magnitudes.

HOROLOGY, *hor-ol'-o-je* (Gr. *hora*, time or hour; *logos*, a discourse), is the art by the principles of which the measurement of time is regulated. In a more general sense, it is the art which takes within its scope a knowledge of the action of certain machines used as time-measurers. It is a difficult thing to give a good definition of time. According to Locke, it is "the consideration of duration, as set out by certain periods and marked by certain measures or epochs." According to Aristotle, "our conception of time originates in that of motion, and particularly in those regular and equable motions carried on in the heavens, the parts of which, from their perfect similarity to each other, are correct measures of the continuous and successive quantity called *time*, with which they are conceived to co-exist. Time, therefore, may be said to be in the perceived number of successive movements." Undoubtedly the motions of the heavenly bodies form

the best standard for measuring time included within lengthened periods; but for the computation of such short divisions as hours, minutes, and seconds, we must call to our aid certain mathematically-adjusted machines, the knowledge of whose construction is regulated by the science of horology. The "father of history" ascribes the invention of the earliest time measurers to the Babylonians. Pliny claims the honour for Anaximenes; whilst Phavorinus wishes us to accept Anaximander as the real inventor. At any rate, the first horologia of which we find mention are the *Polos* and *Gnomon*. The latter, which was the more simple, and, it may be inferred, older instrument, consisted merely of a staff or pole set up perpendicularly in a sunny spot, its shadow being measured upon the place where it fell, and time computed thereby. The *Polos*, or *Heliotropion*, was formed of a basin in which the twelve divisions of the day were marked by lines, and upon these the shadow of a perpendicular staff, set up in the centre of the instrument, was thrown by the sun. In modern days these machines are called sun-dials. (*See* SUN-DIALS.) Such instruments as these must have been known to the Jews, who are inferred to have derived their knowledge of them from the Babylonians; for we find mention made in Isaiah xxxviii. 8, of the dial of Ahaz, whose reign commenced 741 B.C. In 293 B.C., we learn that the Roman general Papirius Cursor set up a sun-dial near the temple of Quirinus, at Rome; and upon the walls of the still standing Temple of the Winds, at Athens, may be seen the lines of a dial, together with the holes in which were fixed the perpendicular pillars or gnomons. But these contrivances could only be of service in marking the progress of time during the bright days of summer. At night, and during the cloudy days of winter, they would be useless. Invention, therefore, had to be further spurred, that a more perfect instrument might be produced. The *Clepsydra* would appear to be the machine which was called upon to make up for the shortcomings of its progenitor the sun-dial. The clepsydra (Gr. *kleptein*, to steal; *hudor*, water), or water-clock, of the Greeks and Romans, was an instrument in which water escaped, as it were by stealth, in a more or less regular flow, from one vessel to another. Closely resembling this was the sand-glass, a more accurate instrument, because a column of sand, of a great or moderate height, will run through an orifice into another vessel at a uniform rate; whilst, in the case of a column of water, no uniform rate of velocity can be obtained, unless the cylinder containing the water be kept constantly full. Another rude form of marking time was the burning of graduated candles, a time-measurer employed by King Alfred. In a general way, all those pieces of mechanism which have for their motive power a weight, or the elastic force of a spring, are called *clocks* and *watches*; but they are also distinguished by certain names, indicative, either of their construction, or of the peculiar offices they are intended to perform. For example,—the name *time-piece* is given to any piece of horological machinery which merely marks the time without striking the hours; a *clock*, besides showing the time, strikes every hour on a bell or spring; a *quarter-clock* strikes the *quarters* of every hour; an *astronomical clock* is one which indicates sidereal time; a *watch* is a portable or pocket timepiece; a *repeater* is a watch provided with a mechanical contrivance, by means of which it can be made, at any time, to repeat the hours; a *chronometer* is a watch of the most superior character, or one that may be used for astronomical or maritime purposes. It is almost an impossibility to state who was the individual that invented either a clock or a watch; and a great deal of the obscurity attaching to the early history of clocks is due to the fact that formerly the term horologium was applied to a sun-dial or a clock indiscriminately, thereby rendering it a task of the utmost difficulty to state at what particular period it came to mean a clock. As far back as the close of the 13th or the beginning of the 14th century, striking clocks were known in Italy. In 1288, as we are told by Coke, a stone clock-tower was erected opposite Westminster Hall, and in it was placed a clock, the cost of which was defrayed out of a fine of eight hundred marks imposed upon a corrupt chief justice of the Queen's Bench. About 1370, a German horologer set up a clock in the tower of the palace of Charles V. of France; and we glean from Rymer's "Fœdera," that in 1368 three Dutch horologers were invited to England [illegible]

[illegible] no means uncommon in private houses on the continent towards the close of the 15th century, and we have some grounds for believing that they were general in England at the same time. Reviewing all the evidence we have before us, the conclusion may be drawn that the name of the inventor of a clock is unknown; that an horological machine driven by a weight is of more ancient date than is commonly allowed; that the clock of Henry de Wyk, which, on account of its having a balance for a regulator, marked the first great era in the art of horology, was not the invention of one man, but the result of a series of inventions made at different times by different persons. According to M. Ferdinand Berthoud, the progression of the successive improvements in horology was as follows:—1. Toothed wheel-work was known in ancient times, and particularly to Archimedes, whose instrument was provided with a motive power, but had no regulating or controlling mechanism; 2. the weight applied as a motor had, at first, a fly, most probably similar to that of a kitchen jack; 3. the ratchet-wheel and click for winding up the weight, without detaching the teeth of the great wheel; 4. the regulation of the fly depending upon the state of the air, it was abandoned and a balance substituted; 5. an escapement-wheel next became indispensable, as constituting, with the balance, a more regular check than a fly, upon the tendency which a falling weight has to accelerate its velocity; 6. the application of a dial-plate and hand to indicate the hours, was a consequence of the regularity introduced into the going part; 7. the striking portion, to proclaim at a distance, without the aid of a watcher, the hour that was indicated, and this was followed by the alarum; 8. the reduction and accommodation of all this bulky machinery to a compact and portable size, as in watches. Through the kindness of Mr. J. W. Benson, the eminent watchmaker of Ludgate Hill, we are enabled to give an illustration of a clock of the most ancient character, having a balance on the top as a regulating medium, and with an escapement of the verge construction. We borrow from the ninth edition of Mr. Benson's illustrated pamphlet on watches the description of this old time-measurer. Without entering into any minute detail of the manner in which motion in a clock is successively communicated from one toothed wheel (G or R) or pinion (*e* or *g*) to another, which, indeed, would only tend to perplex the mind of the general reader, it will be sufficient to state the following:—S is a square piece of steel fixed to and forming part of the pinion P.

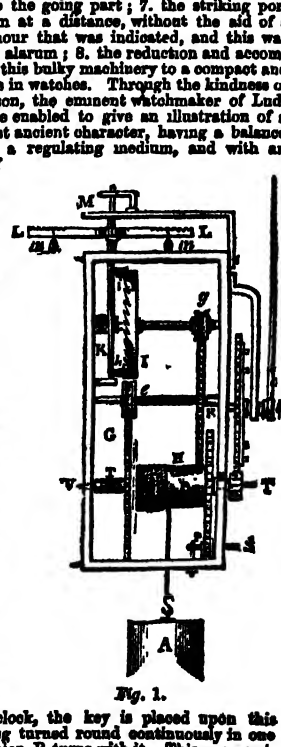


Fig. 1.

In winding the clock, the key is placed upon this square, and being turned round continuously in one direction, the pinion P turns with it. This communicates its motion to the wheel R, which is fixed to the

cylinder B, and which, in its revolution, coils or winds up the cord, to which is attached the weight A. While this takes place, the wheel G is held in check by another wheel, called "the ratchet," and a "click" (neither of which is seen in the sketch); but when the operation of the winding is completed, and the weight A begins to descend, the cylinder B, together with the wheel G, turn on their common pivots V V, and the motion is thus communicated from wheel to pinion, until it reaches the escapement-wheel I. The teeth of this wheel, in its revolution, act alternately on the pallets *i k*, which project from or form part of the spindle or verge K M, and this produces a vibratory or backward-and-forward motion of the balance L L. Were it not for this detention, the duration of which is much increased by the swing of the balance, the weight A would descend with greatly accelerated speed, till, in a few moments, the cord would be entirely unwound from the cylinder, and the clock at rest. The date at which the size of clocks was so far reduced as to render them portable, is uncertain; it must, however, have been anterior to 1544; for in this latter year the corporation of master clockmakers at Paris procured from Francis I. a statute precluding all but master clockmakers from constructing clocks or watches, large or *small*. At any rate, no clock or watch could be made small enough to be portable, without having a "mainspring" substituted for a weight, as the moving power; and whenever this object was attained, then was the second great era in horology reached, as from this period may be dated the application of the fusee, and the consequent total alteration in the form and application of horological machinery. The third era in clock-work was the application of the pendulum. Both the discovery of the pendulum, as well as its application to clocks to supersede the balance, have been a subject of great contention. Some writers, contending that Galileo discovered the pendulum, give to Huyghens the honour of first applying it to a clock. "Pendulums," says Mr. E. B. Denison, in his excellent treatise on clocks and watches, "like many other things, may have been invented several times over, in different ages, or even in the same." An old edition of the "Encyclopædia Britannica" maintains that the ancient astronomers of the East employed pendulums in measuring the times of their observations, patiently counting their vibrations during the phases of an eclipse or the transit of the stars, and renewing them by a little push of the finger when they languished; and Gassendi, Riccioli, and others in more recent times, followed their example. "If so," argues Mr. Denison, "it is plain that this knowledge had itself languished and died before the making of what has long been called Galileo's discovery, in the church at Florence, that a chandelier, and therefore, any other pendulum, vibrated different arcs in the same time, provided there were none of them large ones. When we consider the vast number of pendulums that there are swinging about the world, it certainly is difficult to imagine that nobody ever made that observation before the 16th century. The application of it to the regulating of clocks, however, is a different thing, as that required invention, as well as observation. There seems no doubt, however, that the first person who investigated and established the mathematical theory and properties of the pendulum, was Huyghens, the Dutch philosopher, in the 17th century; but it seems equally certain that the first pendulum clock was made for Saint Paul's church, in Covent Garden, by Harris, a London clockmaker, in 1621, though the credit of the invention was claimed also by Huyghens himself, and by Galileo's son, and Avicenna, and the celebrated Dr. Hooke, the undoubted inventor of the balance spring of watches, and the discoverer of its theory." In order to convey a clear idea of the action of the pendulum, and also to narrate the history of its many improvements, more space would be required than can be spared in this general view of horological machinery. It is therefore proposed to deal with the subject minutely in another place. (*See* PENDULUM.) After the application of the pendulum as the regulating power of clocks, the art of horology made rapid strides towards perfection, and it is generally admitted, even by continental writers, that the more important inventions and improvements belong to the English. The anchor escapement, as a substitute for the old crown wheel, was the invention of Clement, a London watchmaker, in 1680. In 1715, George Graham advanced horology, by introducing the mercury pendulum, and by improving the escapement of Clement. Harrison's pendulum, the dead-beat escapement of Graham, and the gridiron pendulum, were the subsequent improvements. Leaving the subject of clockmaking at this point, as a sketch of its present state will be found under the article TURRET CLOCK, where an account of the history and mechanism of the Exchange and Westminster clocks will be found, it is proposed to take up the history of watchmaking. But first of all, to say something of the assemblage of wheels and pinions called the "movement" of a watch. The wheels in watches are urged on by the force of a spiral spring, contained in a hollow cylindrical barrel, to which one end of a chain is fixed, lapping round the barrel for several turns outside. The other end is fixed to the bottom of a solid, shaped like the frustum of a cone, known by the name of the "fusee," having a spiral groove cut on it. On the bottom of this cone, or fusee, the first great wheel is put. The axis, or "arbor," as it is called in watchmaking, on which the spring barrel turns, is so fixed in the frame that it cannot turn when the fusee is winding up. The inner end of the spring hooks on to the barrel arbor, and the outer end hooks on to the barrel. Now, if the fusee is turned round in the proper direction, it will take on the chain, and consequently take it off from the barrel. This bends up the spring; and if the fusee and great wheel are left to themselves, the force exerted by the spring in the barrel, to unbend itself, will make the barrel turn in a contrary direction to that by which it was bent up. This force of the spring unbending itself being communicated to the wheels, will set them in motion, and they will move with considerable velocity. Their time of continuing in motion will depend on the number of turns of the spiral groove on the fusee, on the number of teeth in the first or great wheel, on the number of leaves in the pinion upon which the great wheel acts, &c. The wheels in any sort of movement, when at liberty, or free to turn, and when impelled by a force, —whether it be a weight or a spring,—would soon allow this force to terminate; for, as the action of the force is constant from its first commencement, the wheels would be greatly accelerated in their course, and it would be an improper machine to register time or its parts. The necessity of checking this acceleration, and making the wheels move with a uniform motion, gave rise to the invention of the "escapement," or "scapement," as it is generally called. To effect this, an alternate motion was necessary, which required no small effort of human ingenuity to produce. The "escapement" means that combination of parts in a watch which has for its object the conversion of the circular motion of the wheels into a vibratory one. Were it not for this, the motive force would have no check. Hence it is by this mechanism that the wheels in the movement are prevented from having their revolutions accelerated, which otherwise would take place to such a degree as to make the machine run down in a minute or two. When, towards the close of the 15th century, springs were placed as the motive power in clocks, it became apparent that timepieces might be rendered portable. We first hear of the manufacture of watches by Peter Hele, of Nuremberg; though it is affirmed they were invented at an earlier date than the period assigned to them. Johannes Cocclæus, commenting on the Cosmographia of Pomponius Mela, published in Nuremberg in 1511, says:—"Ingenious things are just now being invented; for Peter Hele, as yet but a young man, hath made works which even the most learned mathematicians admire; for he fabricates small horologes of iron filled with many wheels, which, whithersoever they are turned, and without any weights, both show and strike forty hours, whether they be carried in the bosom or the pocket." Adding to this, Doppelmayer says:—"This, already written by Cocclæus in 1511, shows in the clearest way that pocket clocks were made at Nuremberg 219 years ago; and he has fairly attributed the invention of them to this artist, since it

was the most deserving of admiration and the newest of his time; and which will be considered as a Nuremberg invention; since, also, clocks of this kind wer for a long time called 'Nuremberg living-eggs,' be cause they at first used to make them in the form of small eggs, which name is to be found in the German translation (chap. 26) of a strange book, which F. Rabelais has left behind him. Hence it is evident how erroneous it is to ascribe, as many do, the invention of small striking clocks, as of the pocket clocks, to Isaac Habrecht, a well-known mathematician, who lived about the beginning of the last century, and dwelt at Strasbourg, whereas our Peter Hele had made them in Nuremberg one hundred years before." In one of the earliest watches, now in the possession of Mr. Octavius Morgan, the whole movement, including plates, pillars, wheels, and pinions, is made of iron, and the wheels have been cut by the hand. There are two mainsprings,—the larger for the going part, and the smaller for the alarum. These are not inclosed in a barrel or drum, as at present; neither is ther fusee or catgut; but the outer end of the coiled sprir is bent back as a hook, and clips round a strong pillar between the plates, as the support and resistance to the force which it is to exert at its inner extremity, which is fixed to the axis of the great wheel. Round this the spring is coiled or wound up, and by its expansion the train of wheels is set in motion. The balance which governs the movement is a small wheel, fixed on the verge as its axis, to which an oscillatory motion is given by the alternate impulses of the teeth of the crown-wheel upon the pallets which are affixe to the verge. This was the earliest escapement invented for watches and clocks, and continues in common use to this day. There does not appear to have been any contrivance for equalizing the power of the mainspring, which, when tightly coiled up, exerted a far greater force than when more expanded; and, consequently, the machine must have been a very imperfect measurer of time. On the arbor, which secured the inner extremity of the mainspring, was fixed a ratchet-wheel, which, by means of a spring fastened to the plate, enabled it to maintain its position, and also allowed its force to be adjusted to the weight of the balance; and this was the only way of regulating these watches. A variety of plans were made use of to remedy this defect; but the most ingenious and best one, moreover, which still continues in use, is the "fusee," the inventor of which is now unknown. After continuing almost at a stand-still for upwards of a hundred years, a great era dawned upon the art in 1658, when Dr. Hooke conceived the idea of regulating the action of the balance-wheel by means of a spiral spring. A watch upon the new principle was made for Charles II., having this inscription upon it:—"Robert Hooke inven. 1658; T. Tompion fecit 1675." The fame of this piece of horological machinery spread rapidly over the continent, and two were constructed for the dauphin of France. Previously to this time, watches had but a single hand; but in consequence of the new regulating power, a minute-wheel and minute-hand could be added. Both these are said to have been given to the watch by Daniel Quare, a London horologer, who also invented the "repeater." The cylinder escapement, with horizontal wheel, was the invention of Tompion, who brought it forward in 1695. This arrangement, which was very valuable, because it made watches more conveniently portable, was perfected subsequently by Graham. In 1705, there came to London Nicolas Facio, a Genevese, who, about five years before, had invented the process of jewelling watches; that is, the application of hard jewels, such as diamonds or rubies, so uninfluenced by friction as to allow the pivots to play in them without wearing away, as metals will do. Without this invention, we should have never possessed the beautiful and useful machine that a watch of the present time is. In 1714, a reward of £10,000 was offered for any method of determining the longitude of any place or ship at sea, within the limit of one degree; of £15,000 within the limit of forty geographical miles; and of £20,000 within

provid[illegible]

eighty miles of the coast. In 1761, John Harrison, stimulated by the hope of gaining these rewards produced an instrument so perfect as to entitle him to the full sum of £20,000, which he subsequently received. Nor was this sum more than an adequate acknowledgement of his great talent; for, twenty-five years before he sent his instrument to sea, he had produced what may be termed the first chronometer. Worthy successors of Harrison have been such horologers as Arnold, Earnshaw, and Mudge. To proceed to describe the various escapements, &c. now in use. The power transmitted to the escapement through the train of wheel-work in a watch, is created by the elastic force of the mainspring, which serves the same purpose as the weights in a clock. (*See* fig. 2.) The mainspring of a watch is a thin flexible ribbon of steel, usually about 16 or

Fig. 2.

18 inches in length, which, when coiled into the barrel ready to be placed in the watch, occupies a space something less than ⅞ of an inch in diameter. To this barrel is attached, by a small hook, the "chain," which is rolled round it, and fixed by another hook to the fusee. When the watch is wound up, the chain is unwound from the barrel on to the fusee. The interior end of the spring being fixed to an immovable axis about which the barrel revolves, and the exterior end to the inside of the barrel, it may readily be perceived how he spring extends itself, how its elasticity forces the barrel round, and obliges the chain to give motion also to the fusee, and thence to the various wheels and pinions. The "verge escapement," as applied to watches, s shown at fig. 3: A, part of the balance; B, the verge body; CC, the pallets; D, the escape-wheel; E, escape-wheel pinion. The verge, or arbor B, of the balance, has two pallets C C, which stand out at right angles, so as to be acted on alternately by the sloping teeth in the opposite sides of the crown or escapement-wheel D. The "horizontal escapement," shown at fig. 4, is so called because the escape-wheel acts horizontally to the axis of the balance. It was invented by Tompion, after whose death it was perfected by Graham;

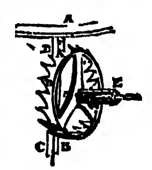


Fig. 3.

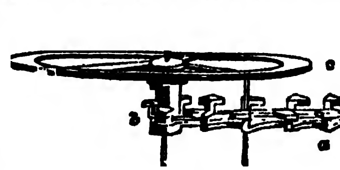


Fig. 4.

a, the escape-wheel, having pins or stems rising from it, on the tops of which are teeth of a wedge-like form, of such a length as to permit little freedom within and without the cylinder *b*, which is firmly fixed to the balance *c*. Although *b* is one piece, the two edges of the hollow part serve as distinct pallets, inasmuch as they receive, alternately, during each vibration of the balance, an impulse from the curved outer edge of each tooth in succession; and, as the wedge-shaped tooth passes from the pallet, the coming tooth falls on the circular part of the cylinder, and there remains until the return of the balance, when that tooth which had previously rested on the circular portion of the cylinder, comes upon the edge or pallet, gives impulsion to the balance *c*, and falls upon the concave portion of the cylinder, and there remains until the balance again returns, when another impulse takes place; and so on in succession. The "duplex" closely approaches

the chronometer. It is shown at fig. 5. A is the escape-wheel, the teeth of which fall upon the roller E (made of ruby), fitted upon the axis of the balance C, and which has a notch F, cut through it vertically. When the balance returns towards the left, the point I of the teeth of the wheel falls into the notch F, and meets with a very small recoil from the balance in what may be termed the returning vibration. This goes so far as to make the tooth for a little while to have the notch at the side opposite to that by which it came in. The balance on returning, in the course of the vibration, receives impulse from the wheel, immediately on the tooth of the wheel of repose B, leaving the notch F, and the small cylinder; at this moment the pallet of impulse D has its face presented, ready to receive the cog I (or upper right tooth of the escape-wheel), which falls and gives impulse to the balance. So soon as the tooth of impulse escapes from the pallet, the next tooth of repose falls, and rests on the small cylinder of ruby E; and so on.

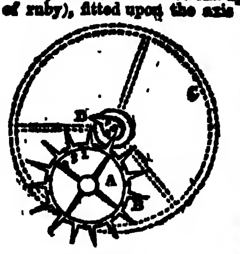


Fig. 5.

The "patent detached lever" was invented by T. Mudge, in 1766. It is shown at fig. 6, *a a* the escapement-wheel, *b b* the ruby pallets, *c* the lever, *d* the balance. On the axis of the balance *d*, towards the lever *c*, is a small disc of steel, into which is inserted a small pin, made of ruby. This pin fits with great nicety into a notch or opening in the end of the lever *c*, upon which are firmly fixed the two pallets *b b*, into which are secured rubies, very finely polished. The balance in its vibration on either side, carrying with it the steel disc and ruby pin, causes that pin to enter the notch in the lever, and carry the lever with it, and at the same time to draw the pallet from off the escapement-wheel *a*. Power being exerted upon this lever by the mainspring, the wheel tooth gets disengaged from the locking face of the pallet, forces itself down the slopes of the pallet, and thus gives impulse to the balance. At each vibration, the same unlocking takes place; but as soon as the wheel tooth falls from the slope, the opposite pallet is prepared to receive the advancing tooth of the escapement-wheel; and so on in succession, beat after beat takes place.

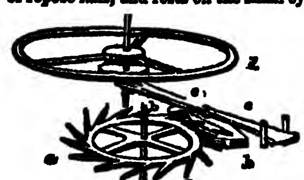


Fig. 6.

The "detached, or chronometer escapement," shown at fig. 7, was invented about 1780. A is the escape-wheel; B the escape-wheel teeth; C the roller, let on the verge or axis of the balance. This roller is a circle of polished steel, with a notch cut out of it, into one side of which, D, a flat polished piece of ruby is inserted for the acting part. Below this steel roller carried on the same verge, is a smaller roller of steel, E, called the discharging pallet, having a sapphire fixed on its outer edge. F is a slender spring, which is screwed at I to the stouter one, having its fixture at the stud L, and polished away very thin at K, in order that it may bend readily, so as to cause very little resistance to the balance while forcing it on one side. G is a projecting piece carrying an upright pin made of ruby, against which the wheel-tooth B rests. At B is a small screw against which the spring LKG strikes, and thus prevents it from springing too far back. The action of these parts is as follows:—When at rest, the circular edge of C is just clear of the two teeth of the wheel B; but yet, if set in motion, the teeth could not pass both F and G whilst they remain quiescent. G rests against the screw at B, and the tooth resting against the locking pallet G, the escapement-wheel cannot turn. To set the chronometer going, it is necessary to give it a rotary motion, which sets the balance in action. This causes the lower piece on the verge (called the lifting-piece or discharging-pallet) to strike against the end of the spring F, which, from its overlapping the curved end of the prolonged spring KG, pushes it back, and thus releases the pin or locking-stone G from before the tooth of the wheel; that is, it unlocks the escapement-wheel, which is immediately set in motion on the action of the mainspring. The same vibration given to balance and verge brings the ruby pallet D round before the tooth B, which strikes against it and carries it round. The recoil of the spring F has now brought the locking-pallet G to catch the tooth B, the escapement-wheel being again stopped. But the stroke of the tooth from the face of the ruby pallet D has carried the balance on in its vibration till it is counteracted by the tension of the balance-spring, which brings it back again in this return vibration; the lifting-pallet E, by its curved back, pushes the slender spring F before it, and passes it without affecting KG, which is stiff enough to remain unmoved by E, even when this strikes and rests against it in recoiling. The wheel, therefore, continues locked on the upright pallet G, and the vibration proceeds uncontrolled till the great pallet is again brought round, and the balance-spring again checks the vibration, the above process being repeated. In this escapement, consequently, part of one vibration in one direction, and the whole of that in another, is performed without the balance being in any way under the influence of the maintaining power; while the parts are so contrived that the impulse given by the tooth of the escape-wheel affects very minutely the natural motion of the balance. It can be easily understood that the lifting-pallet E can pass in one direction the spring F without moving K and G; while in the other it carries F, and therefore G, with it.

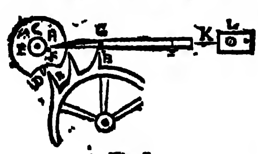


Fig. 7.

The "compensation balance" shown at fig. 8, was the invention of the London horologer Thomas Earnshaw, who received a reward from Government for it. When properly adjusted, this balance causes a watch to keep the same time whether the temperature be 32° or 90°.

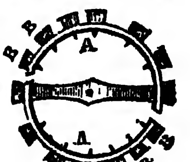


Fig. 8.

The divided rim A A is composed of steel and brass run together by fusion, the more expansible metal, brass, being placed outwards; the result of which is as follows:—Heat elongates the pendulum spring, and thereby causes a slower vibration of the balance; but as the inner rim of steel does not expand so freely as the outer one of brass, the conflicting action of the two tends to draw the free end of the circular rim towards its centre, and thus decreases in all but one direction the diameter of the balance. This decrease tends to quicken its vibration, and thus counteracts the effects of elongation of the pendulum spring. In cold climates, the pendulum spring is contracted, making the vibrations quicker; but the contraction of the brass rim draws the free end outwards, thus increasing its diameter, retarding its vibrations, and counteracting the effect of the contraction of the pendulum spring. Many contrivances have been introduced to test the equality of compensation balances, but the majority have been cast aside, from the circumstance that the heat was not equally distributed to the watches under trial. In pursuance of the same object, Mr. J. W. Benson, of Ludgate Hill, has invented an oven heated by hot water, which has been found to answer perfectly the desired end. In this simple apparatus, even the cheapest watch may be regulated to suit any climate.

Electrical and Illuminated Clocks.—Although, at one time, it was fully expected that electrical clocks would be largely employed, these ingenious machines have never been much used. They are of two kind—electrical dials and electrical clocks, so called. electrical dial has no body belonging to it, but is connected by means of a wire with a standard clock at some other place; as the Observatory at Greenwich. An apparatus is also provided for sending a galvanic current through the wire at certain regular intervals of time. By this means the dial hands are made to leap over a small portion of their course whenever a current is transmitted through the wire; and the time value of this movement is marked by the figures on the dial. An electrical clock, however, is one that carries with it its source of power, and is independent of any wire connected with another place. Electric time-balls are also connected with this branch of the subject. These balls have been found very useful, and show the time once every day. Regularly every day, at one o'clock, a large ball is seen to fall; and by this means mariners and others can correct chronometers, clocks, and watches. The time-ball at Greenwich observatory, and at the telegraph station in the Strand, London are familiar instances of this method of marking time The rendering of clocks visible by night has met with great improvements in late years. The dial is usually made of some semi-transparent glass, lighted up behind with gas. In some cases, however, as in the clock at the Horse-guards, the dial is lighted by reflected light in front.

Clock and Watch Trade.—In England, this branch of manufacture is principally confined to London, Coventry, and Prescot. The district of Clerkenwell is the head-quarters of the trade in London. Watch movements are generally made at Prescot, and other places in Lancashire; the London workmen make the other parts, and put them all together: thus, a Clerkenwell watchmaker buys his movements from Lancashire, and employs tradesmen to finish the making of the watch: these tradesmen are not mere workmen, but small master tradesmen. The motion-work is supplied by one, the spring by another, the escapement by another; while the case, dial, glass, &c., have each their respective furnisher. The work is again subdivided by these tradesmen in a wonderful manner. Different workmen are specially employed on every kind of escapement, motion-work, hands, dials, &c. An ordinary London watch passes through more than a hundred hands, even after the movement has been made in Lancashire. The principal makers of church and turret clocks live in London, and manufacture nearly all their own machinery on their premises. Prescot not only supplies the home trade with watch movements, but exports them to America. Swiss watches have long been celebrated; but although they are minute and delicate, and much cheaper, the best English watches are not equalled by any others in the world for strength and accuracy.—*Ref.* Denison on *Clocks and Watches*; Benson's Pamphlet on *Watches*; Berthoud's *Essai sur l'Horlogerie* and *Histoire de la Mesure du Temps*; Cumming's *Elements of Watch and Clock Work*; Derham's *Artificial Clockmaker*; Harrison's *Principles of his Timekeeper*; Earnshaw's *Explanations of Timekeepers*; Reid's *Treatise on Watch and Clock-making*; the article *Horology* in Knight's *Cyclopædia*, and in Brande's *Dictionary*.

HORSE, *horse* (Ang.-Sax.), (Lat. *equus*), an animal belonging to the fam. *Equidæ*, a branch of quadrupeds distinguished by a single digit and hoof on each foot. Although, however, the *Equidæ* possess but one developed toe, there are on each side of the metacarpus

formula:

$$\text{Incisors } \frac{6}{6}, \text{ canines } \frac{1-1}{1-1}, \text{ molars } \frac{7-7}{6-6}; \text{ total } 42.$$

Of the three great divisions into which the *Equidæ* are separated,—namely, the horse, the ass, and the zebra,—the former is the largest, the most docile, the most valuable, and, finally, more fully distributed over the surface of the globe, than any of the others. That the horse existed prior to the Flood, the researches of geologists afford the most satisfactory evidence; for there is not a portion of Europe, Asia, Africa, or America, in which the fossil remains of this animal have not been discovered, mingled with the bones of the elephant, the hippopotamus, and the deer, as well as the mastodon, and other animals which have passed away from the surface of the earth. In most cases these fossils agree with the size of the horse which exists in the present day; but in South America the bones of horses of gigantic size have been exhumed. The first allusion to the horse occurs in the book of Genesis (xxxvi. 24), where it is said that Anah, son of Zibeon, found the mules—the progeny of the ass and the horse—in the wilderness, as he fed the asses of his father. From the remains of Grecian art and writings, we find, also, that the horse was used for chariot-races and other purposes about 1450 B.C., from which date it became more and more employed for the use of man. It is questionable whether, in the present day, there exist any real wild horses, as those which are so called have been proved, in the case of America, to have been the descendants of horses let loose by the Spaniards; and those of Asia are but the progeny of horses which have escaped from the haunts of civilization. Both fore and hind legs of the horse have, on the inner side, an oval, horny, wrinkled plate, called a wart, sallender, or chestnut. The canine teeth are wanting in mares. The sense of touch, in general, is extremely delicate; the tongue soft; the upper lip capable of elongation and considerable mobility; and the senses of taste and hearing well developed and very acute. The eyes are large and the sight good; while the sense of smell is so particularly fine, that horses which run in a wild state are said to be able to scent their enemies at the distance of more than a league. The skin is generally covered with a coat of short hair, smooth in summer, and becoming rough and much more elongated during the winter season. The best of the wild Asiatic horses are those which inhabit Tscherkessi, Abassi, and the northern slopes of the mountains of the Caucasus. The principal varieties of these, according to Pallas, are, first, the "moustachioed" horse, characterized by numerous strong bristles on the upper lip; next, the "woolly" horse, a Russian variety, covered with a crisp woolly hair, and common amongst the Baschkirs; thirdly, a "naked" or hairless horse, which is found amongst the valleys of Krim Tartary, by the natives of which it is kept always clothed; and, lastly, a variety delineated by Johnston, in which a sort of woolly mane is continued from the neck along the back, right down to the tail, which specimen Pallas asserts that he saw amongst the Buracti. The wild horses appear to be free from nearly all those diseases and ills which prove such a burden to the domestic breed. They are generally of a pale or greyish-brown colour, with brown mane and tail, and a whitish muzzle, which subsides into a black colour about the mouth. They are less in size than the domestic horse, and have a larger head, larger ears, hoofs more contracted, and the mane more erect, whilst the tail is much shorter. They do not wander beyond the 50th degree of north latitude. They generally move about in droves, headed by a larger grey or black stallion, who constitutes himself the leader. On the Pampas of South America they are exceedingly abundant, and the Guachos, a semi-civilized race of men, live amongst them. Their mode of capturing and breaking-in these horses is very curious. The *capitor* (or chief), mounted on a powerful steady horse, rides into the *corral* (a large space inclosed by an impregnable boundary of wooden stakes, into which herds of wild horses are driven by the Indians), and, picking out the animal to be broken in, throws his lasso over his head, and drags him to the gate. For some few moments the idea in the horse is an unwillingness to lose his companions; but when once out of the gate of the corral, he endeavours to escape over the plains; but a timely check of the lasso stops him. The peons then run after him, and throw a lasso over his fore legs, and by a jerk throw him on the ground. In an instant a Guacho seats himself on his head, and cuts off the whole of his mane, whilst another cuts the hair from the end of the tail, in order to show that the animal has once been mounted. They then put a piece of

hide in his mouth to serve for a bit, and a strong hide halter on his head; the Guacho who is to mount him next arranges his spurs, which are unusually long and sharp, and, whilst the two peons hold down the horse, he girths on the saddle very tightly. He then jumps into the saddle, and the other men giving the horse his head, the rider grasps the halter and prepares for action. At first the animal jumps about, sometimes with all four of his legs off the ground at once; but the spurs of the Guacho soon set him going, and off he gallops, doing everything he possibly can to unseat his rider. After galloping him about, and flogging him until every bit of spirit seems taken out of him, the Guacho rides back slowly to the corral, and the horse, so lately unruly, is quite tamed, and fit for domestic use. Immense quantities of the skin of the horse are imported annually from South America; for during the period which elapsed between 1838 to 1842, Monte Video and Buenos Ayres yielded annually about 90,000,000 lbs. of oxen and horse hides, and 9,500,000 lbs. of horsehair. The horse is naturally an herbivorous animal, as his thin muscular lips, with his compressed mouth and sharp incisor teeth, are well fitted for seizing and cropping various species of grass. In a domesticated state, however, he is obliged to eat other and harder food, as oats and corn; and for this a provision is made by nature, who supplies him with a peculiar adaptation of the bones of the face, by means of which the horse can comminute and grind down his food better than carnivorous animals. As the teeth of the horse indicate his age, as well as being distinguished for their adaptation for masticating purposes, it will be necessary to give them some slight consideration. The colt is generally dropped with the first and second molar and grinding teeth apparent. When eight days old, the two incisor teeth (central) come out, and in the next five or six weeks he has the two next incisor teeth supplied. In three months' time these teeth will all be uniform, and a third grinder appears; and, after the colt has attained his eighth month, the third nipper above and below, on each side, will appear, and the colt will be found furnished with his full complement of front teeth. These teeth are provided with an elevated cutting edge of enamel, and this edge is bent inwards and over the tooth, so as to produce a sort of cavity or depression behind it, which constitutes *the mark:* it is gradually worn down by chipping the grass, and is at length totally obliterated. By the degree in which this mark is effaced, we are enabled to judge of the age of the animal. It may also be added that the deciduous teeth are lost in the order of their acquisition; the two middle incisors of both the upper and lower jaws being displaced between the second and third years. A three-year-old colt has the permanent middle incisors above the gum, but not on a level with the adjoining deciduous incisors; these are also characterized by a large deep groove containing a black substance crossing transversely the working edge of the corner of the tooth, and the sixth grinder is also coming into place. At four years the sixth grinder is on a level with the others, the third deciduous grinder is shed, and the mark is fainter. At six years the fissure on the middle incisors is worn away, but a discoloration still exists; at seven years the mark is worn away from the four middle incisors in both jaws; and at eight years the mark will be found gone from all the lower incisors, and ceases to afford any indication of the age of the animal. It may be added, that these marks are sooner worn away in a stall-fed horse (in consequence of its eating more oats and harder substances) than one at grass; and also that they are sometimes prematurely worn away in a "crib-biter." The mare goes with young upwards of eleven months, and foals standing. The age to which horses would reach, if untouched by disease, is not correctly known; many have exceeded thirty and even forty years, but the majority arrive at their end before they have attained their ninth or tenth year. The first change which domestication makes in this animal is in increasing the bulk of his trunk in comparison with his head and limbs; and of all varieties this change is more observed in the Arabian than any other. The head is not only proportionately smaller, but is remarkable for the breadth and squareness of the forehead, the shortness and fineness of the muzzle, prominence and brilliancy of the eyes, and the smallness of the ears. The neck of the Arabian horse is long and arched, and beautifully joined to the chest; the withers are high, and the shoulder-blade has its proper inclination backwards; while the fineness of his legs and the oblique position of the pasterns might be supposed by the uninitiated to lessen his apparent strength; but the leg, although small, is deep, and composed of bone of the densest character. Besides, the tendons are sufficiently distinct from the bone, and the starting muscles of the fore-arm and the thigh indicate that he is fully capable of accomplishing many of those feats which the wandering Bedouins and Arabs of the desert relate of their horses. The Arabian horse generally stands in height 14 hands 2 inches. The Barb is another variety of the horse, and is smaller than the Arabian, which, however, it eclipses in general excellence, although it has not the Arabian's unflagging speed and spirit. The Persian horse is larger than the last-mentioned variety, and is more adapted for warlike purposes than for speed and endurance. The East-Indian horse is from 14 to 15 hands high, and is remarkable for a want of bone below the knee, and a fulness of the hocks, which places it far below the Arabian in the scale of excellence. The Burman horse is very small, but spirited and strong: he is generally about twelve hands high. The Tartar horse is of moderate size, but full of spirit, and very bold, active, and muscular. The flesh of this horse is a frequent article of food amongst the Tartars, who also regularly employ the milk of their mares for domestic purposes. The Spanish horse used to resemble the Arabian considerably, in consequence of an admixture of the blood; but the breed has now deteriorated considerably. The Flemish horse is a large muscular animal, strongly and beautifully formed. We are indebted to it for some of the best blood of our draught horses, and we have still frequent recourse to it for keeping up and improving the breed. The various types of horses will now be given under the head of the English horse, which, in the perfection of its different varieties, eclipses those of all other countries. With regard to the hackney, or road-horse, Mr. Youatt says: "He should be a hunter in miniature, with these exceptions: his height should rarely exceed fifteen hands and an inch; he will be more strong and more pleasant for general work below that standard; he certainly should be of a more compact form than the hunter, and have more bulk according to his height. It is of essential consequence that the bones beneath the knee should be deep and flat, and the tendon not tied in; the pastern should be short, and although oblique or slanting, far less so than that of the race-horse or hunter. The foot is a matter of the greatest consequence in a hackney: it should be of a size corresponding with the bulk of the animal, neither too hollow nor too flat, open at the heels, and free from corns and thrushes. The fore-legs should be perfectly straight; the back should be straight and short, yet sufficiently long to leave comfortable room for the saddle between the shoulders and the *back*, without pressing on either; the road-horse should also be high in the forehead, round in the barrel, and deep in the chest." According, also, to Mr. Youatt, the origin of the better class of *coach-horse* is the Cleveland bay, which breed is confined principally to Yorkshire and Durham. Another breed of horses is termed the "Suffolk punch," from its round punchy form, which is supposed to have originated from a cross between a Norman battle-horse and a Suffolk cart mare: this, however, is only a supposition. According to our author, it was "the very horse to throw his whole weight in his collar, with sufficient activity to do it effectually and hardihood to stand a long day's work." The best dray-horses, of which we see so many splendid specimens in brewers' waggons, are produced by a cross between a Suffolk punch and a Flemish mare. Our fleetest variety is the *race-horse*, the breed of which is traced back to an Arabian stallion introduced into this country by a Mr. Darley; whence it was termed "the Darley Arabian." This horse was the sire of Flying Childers, and the great grandsire of Eclipse, which latter horse ran round the mile course at Newmarket in one minute. A good race-horse is "generally dis-

tinguished by his beautiful Arabian head; tapering and finely set-on neck; oblique lengthened shoulders; well-bent hinder legs; ample muscular quarters; flat legs, rather short from the knee downwards, although not always so deep as they should be; and his long and elastic pastern." Another variety of racer springs from an animal imported into this country, and designated as the "Godolphin Arab." The *hunter*, which is our next consideration, includes the blood and high breeding of the race-horse with the endurance of the hackney, together with a power of leaping peculiarly his own. Mr. Youatt says: "The first property of a hunter is that he should be light in hand; for this purpose his head must be small, his neck thin, and his knees wide. The head will then be well set on; it will form a pleasant angle with the neck, which gives it a light and pleasant mouth." The Shetland and Exmoor ponies are other varieties of the English horse, which are diminutive in size, and unfit for most of the purposes to which we adapt that quadruped. The age of all horses, with the exception of that of racers, is calculated from the 1st of May, no matter in what month they are dropped; and that of racers from the 1st January. It would be impossible, within the proportions of the present work, to enlarge on training, and other circumstances connected with the horse; the reader is referred, for further information, to Mr. Youatt's excellent treatise on the horse.

HORSE-CHESTNUT. (*See* ÆSCULUS.)

HORSEMANSHIP, *horse'-man-ship*.—The natural paces of the horse may be thus enumerated, in their proper order:—the walk, the trot, the gallop, the canter; and perhaps leaping may also be included, as it is undoubtedly a pace belonging to the horse, as to other saltatory animals. First, with reference to the walk, it is considered, when slow, to be the simplest of all paces; but when accelerated, even in the slightest degree, it is not so simple as imagined, for it is often intermixed with motions appertaining to other paces, by a successional displacement of the limbs, out of the more common course. It is stated by a writer in Blaine's "Encyclopædia of Rural Sports," with regard to the description of this mode of progression adopted by the horse, that he found that, supposing the off fore-leg to begin, it was immediately succeeded by the near hind one, but the off hind-leg seemed not to follow the fore-leg at the same time as before (*i. e.* that was in the walk of the pace which he had been previously noticing); but this was nothing more than the alteration of the form of the body, when either the one walk or the other took place. For when the off hind-leg began, it was succeeded by the off fore being lifted up, and when the off hind-leg was set down, the near hind-leg was lifted up. But the off fore and the near hind-legs seemed so connected together by the poise being on the same side, that it was the near hind-leg which appeared to begin the action. The poise being altered by the will [illegible] horse, the off fore seemed to begin, and not to be succeeded by the off hind-foot being set down at the same time after it as in the walk of the pace. The near hind-leg is in both paces (*i. e.* the common walk and the pacing walk) taken up after the off hind-foot is set down; and when the off fore-foot is set down, the near fore-foot is taken up, to make room for the near hind-foot to be set down. In order to render the walk agreeable to the rider, it should be true; that is, it should be conducted by a harmonious and symmetrical elevation and depression, or setting down of the feet. To walk fast requires great liberty in the angles of the limbs, but particularly so in the elevation of the fore-parts, and obliquity of the shoulders; a corresponding length and angularity in the hind-legs is also requisite for the perfection of the pace. In the lan- [illegible] whether it is quick or slow, [illegible] dropped flat on the ground, and not, as is too often the case, the toe being placed first, and then the heel. The breaking of a horse will have much influence on his method of walking; the angles of his limbs will have much more; and not a little will depend on the hand of the rider. One horseman by seat and hand will force the horse to carry his head in the right place, and to elevate and extend his limbs, the one in unison with the other; and another rider, by his bad seat and coarse hand, will bring his horse to stop short and irregularly, and thus so mix the trot with the walk, as to do little more than shuffle over the ground. The maximum of speed in the true walk of the horse is six miles in the hour. There are few animals, however, that have accomplished this; and consequently, five miles per hour is a good rate of speed for a fast walker. The trot is the next pace after the walk, and it is always performed diagonally, the limbs being differently employed, according to the rate of progression, whether fast or slow. There are three varieties of the trot; namely, the moderate, the extended, and the running trot. In the moderate, or slow trot, the diagonal legs (as the off fore and near hind-legs) are elevated, and replaced on the ground together; while the two other legs remain on the ground to support the weight of the horse and his rider. The extended trot of a horse and the run of a man are nearly identical in their manner of employing motive power, as the fore and hind diagonal legs acting in unison form themselves into a sole support, like the single leg of a man; the only difference being that the centre of motion is placed diagonally across it; by which means the superincumbent weight, although moving on two distinct members, produces but one effect. The space of ground usually gone over at each change of the limbs in the fast trot is a sufficient proof that a spring is made in the action, which tends to detach the horse, at one particular moment in the pace, completely from the ground; and that, mathematically speaking, the body is propelled through a space corresponding in ratio to the force employed to gain the impetus. The running trot is often confounded with the darting or elongated trot, from a very erroneous impression that the method of procedure is identical; really, this pace is a compound of the t[illegible] trot and the "amble," and it is not conducted diagonally, as the other varieties are. With regard to the gallop, it is stated by Blaine that it may be properly divided into three varieties, all effected, however, by a propulsive effort of the hind quarters. Of gallops, there are, the racing, or gallop at full speed; the slow, or hand gallop; and the canter; which latter, although treated as a separate pace of the horse, is really but a slow gallop. The first of these varieties, or the racing gallop, is nothing more than a succession of leaps. Simple as it is, it nevertheless cannot be commenced without the intervention of the slower gallop, in which one of the hinder legs is first advanced to establish a new centre; for it would require too great an effort to raise the fore parts at once from a state of rest by means of the loins, and to throw them forward at the first action to a considerable distance by means of the haunches and thighs. "In the extended gallop, the fore parts when raised are forced forwards by the alternate flexions and extensions of the angles of the hinder parts, and as both of the fore and both of the hind legs, in the racing gallop, become opposed to the ground in succession at the same moment, that is, as the two fore-feet beat the ground together and then the two hind; so it is evident that the gallop of full speed is nothing more than a repetition of leaps. Quickly as these leaps are repeated, yet the surface of ground passed over at each of them must necessarily be great to accomplish the pace at which the good racer goes. Hambletonian, in his match against Diamond, is said to have covered 83½ feet of ground in a second; and by the calculations of Mons. St. Bel, Eclipse covered 85 feet of ground in the same time when at the top of his speed."—(*Blaine.*) The hand gallop is a pace between the amble and the racing gallop, and differs from both, from the fact of its not being performed diagonally, and from the limbs not being thrown out and contracted equally, one generally taking the lead, as it were, of the other and being pushed further forward, while the other is more curved. The canter differs from the gallop in consequence of the movements of the legs, instead of being simultaneous, being directly the reverse. At no period of time is the animal wholly in the air, one of his legs being always touching the ground; and this it is that gives the pace its peculiar effect. When it is performed, say, on the right, the horse commences by first placing his off hind-leg a little beyond the other; at nearly the same instant he elevates the fore-hand and places first the near fore-leg on the ground,

 Horsemanship

when the *off*, doubling over and beyond, is placed in instant after it. In the next movement, the hind-legs are thrown in, and, while elevated, the off fore-leg becomes raised from the ground; but the near fore-leg is never elevated until the hinder ones are replaced on *terra firma*. In order to insure the safety of progression of the horse, the Parthians used to place pieces of chalk and stones in the paths of their young horses, so as to accustom them to look to their steps, and to elevate their feet sufficiently; while the Romans tied clogs to the pasterns of their colts for a similar purpose. As *leaping* will be treated of in the article HUNTING, enough has now been said with reference to the natural paces of the horse. It would be impossible to find out who was the first horseman; but there is little doubt that even in the remotest ages of antiquity, men were accustomed to mount their steeds, causing them to career along with that irresistible speed and endurance with which the gen. *Equidæ* are so highly gifted. Good horsemanship seems more innate with Englishmen than with the natives of other countries in Europe, and it has always been considered as one of the corporeal accomplishments of a gentleman. There is a great difference between regimental riding and that of a genuine sportsman, as the following distinction, taken from an article in the *Encyclopædia Britannica*, will show:—"The military seat approaches nearer than any other to that of the *manége*; and, by reason of the horse-soldier having, in general, but one hand to hold his bridle with, is one which gives him great command over his horse, without disturbing his seat. He sits well down in his saddle, or his fork, or twist, with his body erect, and in perfect equilibrium with his horse; his legs well stretched down the sides, with a firm pressure of the calves, as well as of the knees and thighs, and the feet firm in the stirrups. But it is not by any *one* of these aids that he becomes a good horseman. He must be in perfect unison, as it were, with his horse's actions and paces to maintain a good and graceful seat; and in proportion to the just balance of his body will he be able to have a steady hand, a point of vast importance to the dragoon. The importance of this balance, and keeping himself in a proper equilibrium with his horse, is increased by the fact of his not being allowed to rise to the horse's trot, and, therefore, requires a still finer use of the bridle hand." To quote another authority:—"The man who rides with the aid of the proper equilibrium," says Colonel Peters, "will, in case of necessity, know when to apply the strength he has retained with a steady, light hand, and govern every motion according as he finds it necessary for his purpose; play light with his own weight upon the saddle (by a gentle spring in the instep of both feet on the stirrups), with an easy pressure of both thighs, knees, and calves of the legs. When the horse jumps or plunges, then these aids are also requisite to keep the seat; but in an easy, steady pace *forward*, it is most particularly to be pointed out to a young man, and cannot be too often repeated, that to become an easy, elegant, or proper horseman, he must learn to ride with comfort and pleasure to his horse as well as to himself; he must learn to seek his balance from his hip upwards, to keep the body with a slight inclination backwards from the perpendicular, and balance himself thus gradually on his horse in all the different paces; which, of course, cannot be expected all at once. A man that rides by the force of his knees alone, shaking his arms and hands, although he rides his distance in the same period of time that the good rider would, yet he cannot be said to *ride* his horse, or to have any part of his body in the proper equilibrium; but the man who rides his horse with a light, steady hand, and elastic body (which, when disturbed even, has the power of restoring itself to its former seat), in unison with the horse's action, may be truly said to ride in the proper equilibrium." Mounting is the first step in horsemanship; and a certain precaution is necessary in this, as in everything pertaining to horses. The person must approach the animal by walking up to him on the left side, not directly in front, as this might alarm him and make him strike out. The rider is recommended by old writers on the subject to take the reins and the pommel of the saddle in his left hand, after having placed his left foot firmly in the stirrup, and by laying his right hand fast on the hinder part of the saddle, to vault into his seat. When mounted, the first thing to set about is the proper adjustment of the reins. If the horse is to be ridden with a single-bridle rein, the reins must be drawn with the rider's right hand through his left, until the horse's mouth has been placed equally on both sides, and then the left hand must be shut, allowing the little finger to separate the two reins. With a double-rein bridle the same must be done. "The bridle-reins should be held at a convenient length; for, if short, they will discompose the attitude of the body, by pulling the left shoulder forward; and they should be held with a firm grasp, dividing them, as before mentioned, with the little finger. When a horse pulls at his rider, he should advance his arm a little, but not the shoulder, towards the horse's head, raising his hand towards his breast, and the lower part of the palm rather than the upper; but he should not shorten the rein in his hand if he can command his horse without it, or he may lose the proper *appui*, or bearing of his mouth. Old writers recommend the bridle-hand to be held perpendicularly, the thumb being uppermost and placed on the bridle. Modern practice is in favour of the knuckles being

going race-horse over a course, or a hasty hunter over a country, in that form." After due attention has been paid to the holding of the bridle, the *seat* must be the next consideration of thé learner. A great improvement has been made in this respect, by substituting the long stirrup-leathers for the shorter ones which were formerly in vogue. With short stirrup-leathers the rider's seat is thrown back in the saddle, instead of keeping the central equipoise, and, consequently, his weight is thrown on the horse's loins, the weakest part in the body of the animal. The thighs are the most essential parts of a horseman, in giving him a good, firm seat, and on their form will depend the position of the knees, also important to the acquisition of a firm seat. The thighs should touch the saddle and the sides of the horse with their inner surface chiefly, and the knees and toes should not protrude too much. The toes should be turned a little outward and upward; for the toes being turned in, necessarily cramps the knees, and prevents the animal from exerting his strength. The manner in which the foot is placed in the stirrup varies considerably with different riders. "The soldier always, the rider for pleasure or on the road generally, rests on the ball of the foot, with a gentle play of the instep; but the man who rides after hounds, and the jockey when he rides a race, find it necessary to have the foot more home in the stirrup, with the toes turned a little upward, as well as a little outward. The advantages of all this are twofold. First, it gives them more power over their horses, by furnishing them with a more substantial fulcrum; and, secondly, to the man following hounds, it is a great security against the foot being chucked out of the stirrup, by the seat being disturbed in a leap, or from any of those causes which perpetually occur in crossing a country." As an easy seat is most important to persons who are obliged, whether by necessity or pleasure, to ride many hours in succession on the road, the following rules should be carefully observed, in order to obtain the same:—The rider should, in the first place, sit well down in the middle of the saddle, with just that length of stirrup-leather as will admit of the fork clearing the pommel of the saddle. The body of the rider should also incline forwards in the trot, as he thus furnishes a proper counter-balance to the movements of the horse; and, above all things, a steady seat must be maintained, as, unless such is the case, the latter will be incommoded in his pace and distressed beyond measure. As saddles and bridles are important adjuncts to perfect horsemanship, it may be as well to quote the following remarks on the same, by a well-known sportsman:—"Nothing sets off the appearance of a horse and his rider more than a good saddle and bridle; nor does anything contribute more to the comfort and safety of the latter than a well-made roomy saddle, with spring-bars for the stirrup-leathers; stirrups rather heavy than otherwise, and sufficiently large for the feet. Some

persons, not contented with the spring-bars, require spring stirrups as well; but in our opinion, no man can hang in a common stirrup, provided he do not wear thick boots, nor use small stirrup-irons. Of the various sorts of bridles, the snaffle is most in use on the turf, and the curb for military horses, hunters, roadsters, and coach-horses. Not one hunter in twenty has a mouth good enough for a snaffle only, although there are a few horses in every hunt that will not face the curb. Some, however, go very well on the snaffle up to a certain iod of a run, when, all at once, they require the stance of the curb. Such horses should be ridden wi a double bridle, so that the rider may have to the curb bit when wanting." The seat and anship required when following hounds will be f n under the article HUNTING, wherein the subject is discussed.

HORSE-POW one of the most important terms employed in hanical engineering, and it expresses the comparis tween the unity of strength possessed by a st or water-power machine, and that of a horse, for forming a certain definite amount of work in a given . Although different machinists are of opinion th power of the horse, as a standard of strength, is o of great variation, the celebrated engineer James tt fixed it at one constant point; and from his theory, s is able to elevate a mass weighing 33,000 lbs. o high in one minute of time. As this basis is general followed at the present time, all calculations with r d to the capacities and powers of different steam- an ter-power machines are founded on this assumption, a e formula used is as follows:—If we call the effect ssure of the steam upon the piston of an engine (i ndently of that expended on friction and the force quired to move the incidental machinery, as feed-pu ps, &c.), calling this pressure A, the diameter of the piston D, and the velocity of the stroke per minute V, derive the equation, that x, or the horse-power of he engine, will be equal to

$$A\frac{\frac{\pi D^2 V}{4}}{33,000}$$

Now, taking (the effective pressure of the steam on the piston) to e equal to 7 lbs. per square inch, and π (the ratio of the circumference to the diameter of the piston) b ing equal to 3·14159, &c., we can simplify the equation which will now be

$$x=\frac{7\times3{\cdot}14159\times D^2\times V}{33,000};\ \text{or, being reduced, } x=\frac{D^2V}{6,000}.$$

In engines which are fitted with condensing apparatus, this formula ceases to apply, as the point of stroke in which the steam is cut off materially affects the general pressure; and, in the present day, steam-engines are often capable of exerting a force some three times as great as that with which they are credited, an engine of 800 horse-power being able to perform sometimes an amount of work equal to that which would be done by the force expended by 2,000 horses. Two formulas are often adopted by practical engineers for calculating the horse-power of an engine, which, although roughly brought out, are often useful as furnishing an appropriate value, without attaching any importance to the precise indication so given. Thus, if the diameter in inches of the piston is called d, the number of strokes n, and the length of the stroke, in English feet, l; then the H.P. or

$$(1)\ x=\frac{d^2\times\sqrt[3]{l}}{47};\ \text{or (2), } x \text{ or H.P.}=\frac{d^2\times ln}{6,000}$$

The horse-power exercised by falling water is calculated by multiplying the cubic quantity of the water which falls over the shuttle by the altitude of the fall, and the product thus derived by 62·5 lbs. (the weight of a cubic foot of water). As a large portion of real power is lost both by the friction and by the water which escapes from the water-wheel, and which is therefore non-effective, this calculation must be lessened considerably. Working engineers state that the effective results, as compared with those according to the above theory, are, in overshot-wheels, as 30 : 100, and in undershot-wheels, as 80 : 100. Therefore, if we call the quantity of water falling Q, the altitude of the fall H, and the coefficient of the real effective power expressed decimally C, we have the formula that the H. P. of a water-wheel $=\frac{QH\times62{\cdot}5}{33,000}$. The different degrees of power possessed by the horse and other animals will be found given under the article ANIMAL STRENGTH.—Ref. *English Cyclopedia*.

HORSE-RACING.—There is much doubt as to when horse-racing was first adopted as a sport and pastime; but it may be surmised that, as trials between man and his fellow-man, both in speed and strength, must have been nearly coeval with his pristine state, so, when he had subjugated such animals as were swift of foot, he was led to promote emulous racings between them. Chariot-races were most probably those in which the horse first distinguished himself; and the Mithraic festivals in Persia, we are informed by Zoroaster, were attended with chariot-races in honour of the sun. This idolatrous form of worship, accompanied with its games, revelries, and races, extended itself from Persia to Greece and Rome, whence the introduction of horse-racing may be traced into Europe. The Olympic games, first practised at Olympia, are the earliest of which we have any credible account, and the chariot-races in the hippodrome were their greatest attractions. The carriages employed in these games were very small low vehicles, to which from one to six horses were attached, the charioteer standing up in the chariot, in order to urge on and control his steeds. The most opulent citizens in Greece expended great wealth and pains in producing those species of horses which were best adapted to the course; and they thus accomplished the original idea of the institution, which there is hardly any doubt was founded with the express intention of improving the equine breed. It is stated that at one festival, seven chariots were entered in the name of the celebrated Alcibiades, three of which gained prizes, and furnished an occasion to Euripides for inscribing a complimentary ode to the conqueror. Over the bar that ran across the entrance to the lists, a brazen dolphin was placed, and an eagle of the same metal stood upon an altar in the middle of the barrier. A piece of mechanism was attached to both of these, which could be put in motion by the president of the games; so that the eagle would spring up in the air, with its wings extended, to be seen by all the spectators, and, at the same moment, the dolphin sank into the ground, which was the signal for the chariots to range themselves in order for the race. Pindar speaks of no less than forty chariots being engaged in the same race; and when it is remembered that they had to run twelve times the length of the hippodrome in going and returning, and had to steer round a pillar or goal erected at either extremity, the confusion and jostling may be imagined, upon the signal for starting being given. At one of the boundaries, a narrow pass only was left for the chariots, and thus often baffled the skill of the most expert driver; and there were also more than twenty turnings to make round the two pillars; so that at almost every moment some accident or ludicrous incident arose to excite the pity or mocking laughter of the spectators. As it was also extremely difficult for the charioteer to retain his standing attitude in his unsteady two-wheeled car, it often happened that he was thrown out head foremost; and the masterless horses plunging about the hippodrome added to the dangers of the other competitors, who were thus often overturned or discomfited when nearly sure of winning the laurel crown. Besides the statue of Hippodamia, there were also several statues and altars in the course, particularly that of the genius Taraxippus, who, as his name imports, was said to inspire the horses with a secret terror. There is no doubt, however, that some artifice was employed with this statue, to frighten the horses on reaching it; so that the confusion was increased, and greater opportunity allowed the drivers for showing their courage and dexterity. From Greece horse-racing next travelled to Rome; and here we are informed by Plutarch that chariot-racing was first held in honour of Mithras, during the time of Pompey; but it languished until Julius Cæsar restored the institution with increased magnificence and effect. Although the equestrian spectacles of the Romans were modelled much after those seen in the Olympic games

of Greece, yet they exhibited several distinctive features which plainly marked the advancement which had taken place. In lieu of the noble riders and charioteers of the Attic race, the horses of the Roman course and circus were more frequently ridden or driven by slaves and other persons employed for the express purpose, than by the owners themselves, who merely looked on their triumph or defeat, without personally taking part in it; and yet, notwithstanding this, the Romans were far more enthusiastic, both as jockeys and charioteers, than the Greeks; for horse-racing seems to have been their principal amusement. The mounted races of the *certamina equestria* were a favourite exercise; but saddles were not then in use, and it seems surprising how some of the riders could perform the feats which it is asserted that they did; such as leaping up and down from their horses, lying at length on their backs, standing upright on them: these riders were termed *desultores*, or leapers, and seem to have resembled those of our own theatrical circuses. In the Roman racing, as in the Grecian, certain prescribed rules and regulations were rigidly adhered to, and those competitors who went against them were deemed to have lost their chance. They were obliged to enter their names and send their horses to a given place at least thirty days before the races commenced; and a species of training was imposed during this interval, not only on the horses, but also on the jockeys and drivers of chariots. Like our own custom, the longer courses were appropriated to aged horses, and the shorter ones to colts; mares ran against mares, as at the Epsom Oaks stakes; while there were both a clerk of the course and a judge, who had all authority vested in themselves. The Roman jockeys rode in different colours, as ours do now, particularly the companies of charioteers, in order that the lookers-on might know the several owners. The principal colours used were, according to Kennet, four; namely, *prasina*, or green; *russata*, red; *alba* or *albata*, white; and *veneta*, sky-blue. We read in Suetonius, that Domitian added two more colours,—golden and purple; but those were soon laid aside after his death, and the old ones adhered to. It is supposed by historians that the first British chariot-races were introduced by the Romans shortly after their invasion of England, and there is every probability that this supposition is based on a true foundation. The first authentic account of local races which we read of, is that referring to the races held at Smithfield, where we are informed by Fitzstephen that races were common enough in the reign of Henry II. Between this period and that of the times of Henry VIII., we learn little or nothing of horse-racing; but during the latter monarch's reign it met with great improvement, a revival having taken place in the sport. Randel Holme, a Chester antiquary, states that, on Shrove Tuesday, the company of saddlers at Chester presented "the drapers a wooden ball, embellished with flowers, and placed upon the point of a lance. This ceremony was performed in the presence of the mayor, at the cross in the Roody, an open place near the city; but this year" (1540), observes he, "the ball was changed into a silver bell, valued at three shillings and sixpence, or more, to be given to him who shall run best and furthest on horseback before them on the same day, Shrove Tuesday. These bells were denominated St. George's bells; and we are told that, in the last year of James I., John Brereton, innkeeper, mayor of Chester, first caused the horses ...... for this race, then called St. George's race, to start from the point beyond the new [illegible]

[illegible]

and, perhaps, the origin of plate-racing. Newmarket was first made a favourite spot for turf exploits at the commencement of the reign of Charles I., and by that monarch also races were established in Hyde Park; he likewise altered the prize to a silver or gold cup instead of a bell. Cromwell kept up a stud, and devoted considerable pains to the improvement of horses, although the fanaticism of the times prevented the continuance of the race meetings. With the Restoration, however, all field sports received a fresh impetus; and amongst them the turf came in for even more than its fair share of encouragement, as Charles

took it under his especial patronage. He [illegible]sent his master of the horse to the Levant, in order to purchase brood mares and stallions, principall[y] B[arbs and] Turks; and to these he devoted so much [illegible] [B]arbs and time, that the breed of race-horses becam[e] [illegible]uble and ably improved. So enthusiastic was Charl[es] consider- his favourite sport, that he entered his ho[rses] [illegible] in this, own name; and it is said that most of the [illegible] in his rules and regulations emanated from [illegible] at turf the reigns of William III. and Ann[e] During patronage was given to the turf,—du[ring] some royal reign particularly, George, prince of [illegible] [durin]g the latter imported several racing stallions, [illegible] mark, having guished for the excellence of the stu[d] being distin- up. Mr. Darley, also, in this reig[n] [w]hich he kept ward the claims of the Arabian [illegible] brought for- we are indebted for the racers of [illegible]; and to him strength, and speed, that we possess [illegible] [unequ]alled beauty, George II. did little for racing, and t[he] the present era. said of George III.; but in the latter [illegible] [th]e same may be great improvements were made, and [illegible] reign, however, of the greatest ornaments of the tur[f] [E]clipse was one From this celebrated racer the mo[st] (*See* HORSE.) may be traced, as Eclipse is said to h[ave] [i]n race-horses of upwards of one hundred and sixt[y] [h]ave been the sire So much for the history of racing [illegible] winning horses. enter into the theory and prac[tice] [illegible] it is now time to itself. The first thing which has [illegible] [th]e of the subject the education of the racer, is [illegible] be attended to in and this is commenced gener[ally] [illegible] [break]ing in" the colt; about twelve months old. The g[reat] [w]hen the animal is at in this rudimentary system [illegible] points to be aimed command obedience and inspire c[onfidence] [illegible] education are, to are not well grounded into the c[olt] [co]nfidence; for if these future career will meet with [illegible] [co]lt at an early age, his application of the cavesson is [illegible] [m]any obstacles. The applied to all colts, whether [illegible] [th]e first active restraint not; but with racers the colts [illegible] [de]stined for the turf or first, in order to prevent the[m] are generally "booted" together whilst "lounging." from rubbing their legs long halter attached to th[e] The colt is bitted, and a strap, which the trainer hol[d]s front part of the nose- walks behind the animal wi[th] [hold]s in his hand, while a lad on by cracking it, withou[t] [i]n a whip, and urges him In three or four days, wh[en] however, whipping him. at full length of the rein [illegible] they go boldly and freely fifteen or twenty minut[es] each way in the lounge, for brought to this pace and [illegible]s, having by degrees been ing-bits, rollers, and cr[illegible] time of lounging, the mouth- when the colt has beco[me] [cr]uppers may be put on; and saddling him is the n[ext] [beco]me accustomed to them, the the first time this op[eration] [n]ext step to be gained. For [ca]ution and care; the [op]eration requires the greatest tight, and the stirrup[s] [th]e girths should not be drawn loose; while the "be[aring] [stirru]ps should not be left hanging be gradual, and "r[eining] [be]aring up" of the bridle should roughly pressed on [illegible] [re]ining back" must not be too his shoulders and [illegible] colt, by way of suppling Mounting him [illegible] sensation to the mouth. tempted, and whe[n] [illegible] be only very carefully at- with the saddle o[n] [illegible] he seems to be quite at home, be familiar with t[he] [illegible] his back; and the colt should him." In Darvill['s] [th]e person who first essays to "back that the giving a g[oo]d [illegible] work *on Training*, it is truly stated be thus undertake[n] [go]od mouth to the young racer must hand in the appl[ication] :—"To accomplish it requires a light in the colt's mou[th] [app]lication of the pressure with the bit giving and takin[g] [mou]th. It should be done by the rider's the colt's mouth [takin]g by gentle pulls, and thereby keeping [r]ider should occ[asionally] [th]e alive to the pressure *of the bit*. The legs and heels [oc]casionally gently press the calves of his up to the bit, [illegible] to the colt's sides, to urge him on and a few moment[s] [p]ulling him up, and letting him stand for again moving [illegible] [a]nd then reining him back a little, and go in any d[irection] [illegible] forward, teaching him to turn and [t]reating him [illegible] that may be required of him; only by pati[ence] at the same time with kindness." It is be trained [illegible] [pati]ence and gentleness that the colt can thu[s] hard, a cl[illegible] [p]roperly; and when the mouth is very be early [illegible] [illegible]rein is sometimes necessary. Colts must and br[illegible] [accus]tomed to crowds, and all sorts of noises may ha[illegible] [illegible]ng, in order to obviate any tendency they of Rur[al] [illegible] to starting. Blaine, in the "Encyclopædia [S]ports," remarks that "the full breaking of [ho]wever, at periods so early as is now not un- [illegible] has laid the foundation of the deterioration

so complained of among the breeds in general. Nevertheless, as the habit is fixed, we also are forced to recommend that a very early handling of all colts may be a common practice. They should also, when yearlings, be accustomed to wear a head-stall, and, occasionally, a surcingle, that they may be led about, to inspire them with confidence, and teach them obedience. It would likewise be prudent to supple them thus early, by a little lounging in a circle; but, further than this, were the horses only concerned, we would not recommend; indeed, were the real welfare of our blood breeds consulted, instead of two-year olds being brought to the starting-post, none would appear there before they had seen at least four summers; and if five had passed over their heads, it would be better for themselves." The training of race-horses depends naturally on their age, condition, and constitution; and the processes by which they are rendered capable of racing vary accordingly. A four- or five-year old must be trained so as to be able to run a course of from two to four miles; therefore, such a horse must in his exercises be habituated to go, at a good telling pace, a much longer distance than that which he will be obliged to do when he comes to the post. If he be deprived of that good training made commensurate with the length of the course he will have to run, he cannot obviously be expected to continue at a winning pace any considerable distance. It is also highly important that he should have his training sweats and gallops carried up to the time of his going to the post. If he is a hearty-feeding horse, not a sweat must be lost, as, if so, he would be found to have superfluous flesh on the day of the race, which would consequently incapacitate him for his trial. The careful trainer will also calculate what flesh best supports a horse, some horses being able to perform well under a load, and others not, unless nearly skin and bone. According to the authority quoted, training exercises for race-horses are confined to walking, cantering, and galloping; trotting forming no part of turf practice. Early in the morning, the horses having been rubbed over and combed, each being mounted by a boy, the whole are ridden out of the stable in their body-clothes and hoods, into the stable-yard, where they continue to walk round and round as long as it is thought necessary to steady the colts, and settle the saddles to their backs, which it is very necessary to do, to prevent the vice of kicking from growing on them. In very bad weather, the court-yard is often the limit of their exercise; but at all other times, they proceed to the ground, or "tan gallop," where they walk for a longer or shorter period, in proportion to their fitness for light or strong work. Sweatings are important agents in training, as by this process the body of the horse is relieved from all unnecessary matter; they promote speed, by lightening the body, and give increased endurance, by clearing the air-vessels. The process by which this is done, is to envelop the horse in blankets and heavy clothes, and start him into a canter; after which he is stripped and rubbed down, and his clothes resumed. Racers are generally clipped once in the winter; but if their coats be extremely rough, the process is repeated a second time. So much for the horse itself; but as one or two other incidental circumstances are connected with horse-racing, the jockey may be mentioned next. According to Nimrod, he should "possess the following not every-day qualifications:—considerable bodily power in a very small compass; much personal intrepidity; a kind of habitual insensibility to provocation, bordering upon apathy, which the efforts of an opponent in a race can get the better of; and an habitual check to the tongue. Exclusive of the peril with which the actual race is attended, his profession lays a heavy tax on the constitution. The jockey must at all times work hard; but, the hardest of all tasks, he must work upon an empty stomach. During his preparation for the race, he must have the abstinence of an Asiatic; indeed, it too often happens, that at meals he can only be a spectator;—we mean during the period of his wasting. To sum up all, he has to work hard, and deprive himself of every comfort, risking his neck into the bargain,—and for what? Why, for five guineas if he wins, and three if he loses a race. The famous Pratt, the jockey of the no less famous Gimcrack, rode eleven races over the Beacon course in one day, ... that he should be able to stand easily in his stirrups, so as not to be so much raised above the saddle that the bridle is required as a means of support. Just before a race commences, the horses are ushered forth from their stables, and brought up to the "paddock" with their clothes on, when the business of stripping and saddling is commenced; and few things take the eye of the spectator more than the smallness and lightness of the jockeys' saddles, some of which weigh barely two pounds. A four-pound saddle is generally preferred by light weights, although a seven-pound saddle is often the favourite with some race-riders. All racing saddles are made of the very best materials, in order to avert any evil consequences which might accrue both to the horse and his rider from the acidental slipping of a strap or the rupture of a girth, or similar casualties. The horses, after being saddled, are mounted by their jockeys, who take a preliminary canter to get them in heat for the forthcoming race. They are then pulled up and ranged in a line at the starting-post, from which they go off at the signal given by the starter, who drops a flag for the purpose. As some horses are restless and uneasy, a reasonable indulgence is given by the judge for "false starts," and the whole batch are called back to the post, and started once more. In a short course, the speed is generally husbanded until the finish, when the jockeys go to work with spur and whip to make the most of their various chances. In a long race, however, of three or four miles, if a jockey is mounted on an aged horse, and the rest of the competitors on two- or three-year olds, he generally puts forth the best speed at first, in consequence of his own horse being able to last twice the distance that the others can; and when they are exhausted, he is able to go in to win, on account of the superior endurance of the animal which he bestrides. There are about 120 race-courses in Britain; of which, according to the "Racing Calendar," there are six in Wales, nine in Scotland, eight in Ireland, and the remainder in England. Newmarket bears away the palm as the metropolis of racing; and after that come Epsom, Ascot, York, Doncaster, and Goodwood, all of which are celebrated for important races run during the year. The Turf is governed by the rules and regulations which were first instituted in its interest, and over it presides a court of honour, termed the "Jockey Club," which annually elects the different stewards of races, and decides all disputes which may arise during the settlement of matches, wagers, and similar sporting matters.—*Steeple-chasing* or *-racing* ought to be characterized as a hybrid species between hunting and true racing, and thus, as is well remarked, it may be considered as a substitute for the hunter's stakes of the turf, without the tendency to become debased by the fraudulent manœuvres which have too often deteriorated the character of the turf. Until recently, steeple-chasing was confined to Ireland; but of late years it has obtained a recognized status amongst British sports, and is getting more and more a favourite with the gentlemen of the country. The ground is marked out the morning of the race, unknown to the competitors, and leaps and jumps are included in the course to be gone over.—*Hurdle-racing* is a species of steeple-chasing; but, the leaps being only over low flights of hurdles, it is not so dangerous, and consequently less exciting. Racing is now reduced nearly to a speculative concern, and it is incredible what sums have been lost and won in backing and betting against horses. The betting-rooms at Newmarket and at Tattersall's, at Knightsbridge, are the principal betting markets; but turf speculations in a minor degree extend over every town in England where a race-course is situated. (*See* HORSE, HORSEMANSHIP, and HUNTING.)

HORSERADISH. (*See* ARMORACIA.)

HORSE-RAKE, an agricultural tool, of the toothed kind, of various sizes and forms, used for different agricultural purposes, and worked by horses. The drag-rake, in its simplest form, is merely a long cross-head with a row of teeth placed in it. In some, these are straight; they are, however, generally bent, with their points projecting forwards. Rakes of this kind are

used on fallows, when foul, to remove the couch-grass, and act as a harrow in getting together the rubbish. In harvest time they are sometimes used as an ordinary rake, to collect the loose corn which may have escaped from the scythe or sickle.

HORTICULTURE, *hor'-ti-kul-ture* (from Lat. *hortus*, garden), that branch of knowledge which relates to the cultivation, multiplication, and amelioration of the vegetable kingdom. The principles upon which the art of horticulture depends are borrowed from the general sciences. For the facts and theories of vegetable physiology it is indebted to botany; for assistance in regard to the nature of soils and manures, to chemistry; and for a knowledge of many circumstances affecting garden labour, to meteorology. Until lately, horticulture was practised and treated superficially;—hence it advanced slowly. But in recent times it has progressed rapidly, since it has been placed on a strictly scientific basis; and a close adherence to the laws of vegetable physiology has taken the place of the prejudices of former times. In the article GARDENING will be found a history of that branch of rural economy, considered as an art of design and taste. In this article, the horticulture of Great Britain will be more particularly alluded to. The subject is divided into three classes;—the fruit, kitchen, and flower garden; the first two, however, usually occupy the same locality. In many works on horticulture, fruits and culinary vegetables are treated as inseparable; but it is best in practice, especially where high culture is attempted, to keep the kitchen-garden distinct from the fruit-garden. This systematic arrangement, however, applies more particularly to large establishments, where order and system are leading features. In forming gardens of this sort, great attention is required to the size and situation. Ground having a gentle inclination towards the south is considered very desirable. On such a slope the greatest possible benefit is derived from the sun's rays, and the process of draining is easily effected. Shelter is another object especially necessary. Either natural rising grounds, or masses of trees, supply the shelter required; but the latter should not be nearer than 150 or 200 feet. The purpose of such screens is to break the force of the winds. Water is one of the most important elements in vegetation, and it is "the life and soul of a garden." In form, gardens are generally either square or oblong, and ought to be protected by an outer boundary, formed by a sunk wall or ha-ha, surrounded by an invisible wire fence to exclude hares and rabbits, or by a hedge and low wire fence on its inner side. Peaches, apricots, hardy grapes, and most of the delicate French and Flemish pears, require walls for their production in this climate. Walls facing the south are set apart for the more tender kinds of fruit-trees, while the east and west walls are set apart for fruits of a more hardy character. These walls are made either of brick or stone, and some are heated by means of heated air or steam passing through flues constructed in the interior. A considerable portion of the wall facing south is usually covered in with glazed structures, called hothouses or forcing-houses. (*See* FORCING, HOTHOUSE.) In many cases, the houses for ornamental plants are attached to these; but their position is properly in the flower-garden. The principal operations in the fruit-garden are propagation, planting, training, and protection of the blossom. Fruit-trees are propagated by seed, by layers, by grafting, and by budding. The process of laying is not much used in horticulture; but is occasionally employed as the means of dwarfing trees. It is thus described by Lindley:—"Laying is nothing but striking from cuttings, which are still allowed to maintain their connection with the mother-plant by means of a portion at least of their stem." Apple and pear trees, and sometimes plum and cherry trees, are propagated by grafting. (*See* GRAFTING.) Most kinds of fruit-trees may be propagated by budding. The process consists in removing a portion of the bark from one tree and inserting it in a slit of the bark of another tree. A strong shoot is thrown out in the next spring, and to this the stock is headed down in the course of the summer. There are several other important divisions of this branch of horticulture; namely, the planting of fruit-trees and the training of standard and wall trees, and, lastly, the culture of fruits. Although the fruit and kitchen gardens afford the most useful occupation to the horticulturist, the cultivation of flowers affords the most pleasing. At first, it is probable that flowers were confined to small portions, or borders in a garden, as is still the case in many old places. But with the advancement of the art, separate departments have been allotted to them, under the name of flower-gardens. Two varieties of flower-gardens have prevailed in England; one in which the ground is turf, with a variety of patterns cut out of it, and planted with flowers and shrubs; and another where the flower-beds are separated by gravel walks, without any turf. Flower-gardens being objects of pleasure, taste must be the guide in laying them out. In all ages, flowers have been universally cherished. The ancients paid particular attention to them, and they were in great request at the entertainments of the wealthy. They were scattered before the triumphal cars of conquerors and formed the distinguishing symbol of many of the deities. At the present day, in Europe, every city has its flower-market for the sale of bouquets and ornamental plants. Botanical gardens, containing conservatories and hothouses, for the production and cultivation of delicate or rare flowers, are also to be found in connection with nearly every large town. The collection of flowers in the gardens and conservatories at Kew, in this country, is unsurpassed by any other in the world.—*Ref.* Lindley's *Theory and Practice of Horticulture*; Loudon's *Encyclopædia of Gardening*.

HOSANNA, *ho-zăn'-nă*, a shout in praise of God, or an invocation of blessings. In Hebrew, it literally means *save now*, and the Jews call their feast of Tabernacles the *Hosanna Rabba*,—in other words, the great Hosanna. Anthony Nebrissensis observes, after Rabbi Elias, that the Jews call the willow branches which they carry at the feast, *hosanna*, because they sing hosanna, shaking them everywhere. The word itself was used in all their prayers. According to Buxtorf, it meant, *save, I pray*.—*Ref.* Hook's *Church Dictionary*.

HOSEA, *ho-ze'-ă*, one of the canonical books of the Old Testament, and the first of the minor prophets. The prophecies of this writer are principally directed against the ten tribes before their captivity, and the tenour of the whole, while threatening them with punishments for their disobedience, shadows forth the advent of the Messiah, and the future stability and good fortune of the Church.

HOSIERY MANUFACTURE, *ho'-zhe-ă-re* (from Sax. *hos*, coverings for the legs).—The manufacture of stockings, or coverings for the feet and legs, forms a considerable portion of the commerce of this country. It is principally carried on in Derby, Leicester, and Nottingham. Silk goods are generally manufactured at Derby, woollen hosiery in Leicester, and cotton in Nottingham. Next to the common warp-and-weft loom, the stocking-frame is the oldest machine in existence applicable to textile fabrics. Its inventor was the Rev. William Lee, of St. John's College, Cambridge, who lived about the close of the 16th century. A considerable period elapsed, however, before his invention was adopted, as trunk hose were then much worn in this country by all classes who could afford such an article of apparel. Lee accordingly settled down in Normandy, and carried out his manufacture under the patronage of Henry IV. The assassination of the king, and other political events, occurred shortly afterwards, and Lee went to Paris, where he died in great poverty. The stocking-frame received little or no improvement in its form till comparatively very lately. Frames with a rotary motion, worked by steam, are now much used at Nottingham, by which much time and labour are saved. The working of one of these frames, in which twelve fashioned stockings are made at the same time, requires only the superintendence of one man and a boy: in the old frame it required one man to make a single stocking. The process of manufacture of hosiery is a peculiar kind of interlacing, being a series of loops or links in one continuous thread; it is not unlike several kinds of ladies' netting, or crochet-work. The completed work, after leaving the frame, is not a stocking, but a piece-

of knitted-work cloth, which is afterwards sewn up into a stocking by means of a needle and thread. Hence three varieties of operatives are engaged in the manufacture of hosiery,—the winders, who put the thread into the machine; the frame-work knitters; and the seamers, who make the stockings out of the cloth produced. The winders are usually children; the knitters are men or women, who hire the winders and seamers; and the seamers are women. Many other articles besides stockings are made of the knitted fabric manufactured in the stocking-frame; amongst these may be reckoned gloves, drawers, pantaloons, caps, jackets, comforters, &c. The processes for worsted, cotton, and silk, are nearly similar; but the greatest care is required for silk articles. The exports of hosiery from this country are very considerable, but the trade finds much foreign competition, especially from Saxony. In 1857, the export of cotton stockings alone amounted to 1,020,000 pairs, the value of which was estimated at £312,000.

HOSPITAL, *hos'-pit-ăl*, a name given to a building set apart for the purpose of receiving sick, infirm, and helpless persons; the building itself being endowed and supported by charity; from which source, also, medical attendance is provided gratuitously for the in and *out-patients*. The name hospital was generally given in early ages to all houses which were kept open for the reception of travellers; and many of the charitable endowments in England are distinguished by a similar title, and are incorporated bodies, consisting of a master and brethren, and occasionally other extraneous members: the name, however, is now restricted to the sense explained above, with a few exceptions; as the Foundling Hospital, for the reception of illegitimate children abandoned by their parents; Christ's Hospital, for the education and classical instruction of youth; Bethlehem and St. Luke's hospitals, for lunatics; and Chelsea and Greenwich hospitals, for the reception of aged and infirm soldiers and sailors. It cannot be surprising that need has been seen, in large cities, for these hospitals, in the true sense of the word; and London, perhaps, is better supplied in this respect than any other city in the world, not excepting Paris. Even at the earliest times they were known; and hospitals for the poor and sick may be deemed one of the greatest characteristics of Christianity. The first hospital for the sick is said to have been founded in the latter part of the 4th century. As early as the council of Nice, in A.D. 325, they are spoken of as commonly known. The first celebrated one which we read of was that endowed by the emperor Valens, at Cæsarea, about A.D. 370. In London there are many of these noble institutions, and they will be found noticed under their separate names; as BARTHOLOMEW'S HOSPITAL, GUY'S HOSPITAL, &c., nearly all of which are very wealthy, and are supported by endowments, apart from general charity. In Low's "Charities of London for 1862," it is stated that there are 14 general hospitals, making up 3,526 beds for in-patients, which, during the year 1861, received 32,199 in-patients, and had 399,146 out-patients under treatment. There are also 66 special institutions which come under the same heading, and which may be thus analyzed:—1 for Germans, 1 seamen, 1 Spaniards, 1 fever, 4 consumption, 8 lying-in, 4 diseases of women and children, 3 for sick children, 3 for incurables and paralytic, 3 small-pox and vaccination, 5 ophthalmic, 1 for diseases of the ear, 9 distortions and internal affections, 4 diseases of the skin, 3 convalescent asylums, 6 lunatic asylums, 1 idiot, 3 institutions for nurses, 1 homœopathic, 1 mesmeric, 1 dental, and 2 sea-bathing institutions. The total number, therefore, of hospitals and infirmaries receiving in-patients is 49; of which we find that three have been in operation 300 years, ten above 100 years, and seven from 50 to 100 years. One of the greatest characteristics of the London hospitals is a noble one, and that is, that they are open to the reception of accidents or urgent cases at all hours, *without letters of recommendation*. The construction of hospitals is a subject which has of late years much engaged the thoughts of architects, physicians, and sanitary reformers; and many systems have been proposed as emendations on the old opinions. The *pavilion* and *corridor* styles have been brought up in contrast; but it would be impossible in the present article to enter upon their different advantages. Suffice it to say, that hospitals for the sick should be well situated, thoroughly drained, soundly built, and not hemmed in by other buildings; and the rooms and galleries for the reception of the patients should be lofty, well lighted, and effectively ventilated.

HOSPITALLERS, *hos'-pit-tăl-lers*, in its original acceptation, a term applied to certain religious bodies, residing in *hospitals*, who held it their sacred duty to supply lodging and entertainment to all engaged in pilgrimages. One of the most celebrated of these was the institution of the Knights Hospitallers at Jerusalem. This was a well-known religious body instituted about the end of the 11th or beginning of the 12th century, and much favoured by Godfrey de Bouillon and his successor Baldwin, king of Jerusalem. At the commencement of the 12th century, it is stated that they came to England and had a house built for their order in Clerkenwell, and became more celebrated, with a greater share of importance attached to them, than any similar body in Europe. In costume, they followed the rule of St. Augustine, and wore a black habit with a white cross embroidered upon it. They were first termed Knights of St. John of Jerusalem, afterwards Knights of Rhodes, and latterly Knights of Malta; those two islands having been conferred upon them by different monarchs. The order was suppressed in England in the reign of Henry VIII.

HOSPODAR, *hos-po-dar'*, a title, called also Woiwode, borne by the princes of Moldavia and Walachia, who are invested with the authority of the Porte, whose lieutenants they are. The Porte also gives them a standard, and they are under his protection, and obliged to serve him. He can depose them at any time he likes; but, in other respects, they are esteemed as sovereigns in their own dominions. By the treaty between Russia and Turkey in 1829, these officers were appointed to hold their offices for life, and are obliged to pay a fixed annual tribute to the Porte. The present government of both the principalities of Moldavia and Walachia is vested in one *hospodar* alone. In consequence of some difficulties which arose with Turkey in 1861-62, these principalities may be now deemed almost independent.

HOST, *hoaste* (Ang.-Nor.; Lat. *hostia*, a victim), a term applied, in theological language, to the consecrated bread or wafer used by the Roman Catholic church in her celebration of the Eucharist. It is unleavened, thin, flat, and of circular form, and has certain mystic signs impressed on its surface. The host is supposed, after being blessed, to be no longer bread and wine, but to be transformed into the real body and blood of Christ. (*See* TRANSUBSTANTIATION.) In all Catholic countries the elevation of the host is a ceremony which is generally adopted at certain times and seasons, when the consecrated wafer is raised aloft and carried in procession through the churches and streets of the city, the people falling on their knees and worshipping it in its passage past them. This custom is said to have originated in the 12th century, when it was thought necessary to make this public and conspicuous declaration of the Eucharist, on the occasion of Berengarius promulgating his opinions against transubstantiation.

HOSTAGE, *hos'-tāj* (Ang.-Nor.; Lat. *hospes*, a guest), a person delivered to an enemy or hostile power as a pledge to secure the performance of a treaty, or stipulations of any kind, and on the conclusion of which the person is to be released. Formerly the custom of taking hostages was so common that it gave rise to many questions in the law of nations; but now it is almost unknown in the relations between civilized communities. Hostages were divided into two different classes,—principal and accessory; the latter being when it was expressly stipulated by the treaty that the hostage should be answerable for the event. One of the great points argued during the middle ages, in international law, was whether such a hostage could take his life, and whether, if he did so, it was lawful to take the same. It has also been questioned whether a hostage could be delivered up against his will, although Grotius decides the question in the affirmative.

HOT-BLAST, *hot'-blast*, in Metall.—The mass of air passing through a blast-furnace is about six tons per

hour. Of late years, much time and expense have been saved by using air already heated by a separate furnace to 600° or 700°. By using the hot-blast, many varieties of air before useless have been brought into use; and although for some purposes hot-blast iron is not so much used as cold-blast, still the increase of the iron manufacture has been very great since the introduction of this system. (*See* IRON MANUFACTURE.)

HOTEL, *ho-tel'* (Fr.), a word which signifies, in its general sense, a large inn for the reception of strangers; but which, in a restricted sense, particularly in France, is identical with the word palace, or mansion, and it is applied to the residences of the emperor, nobility, or other persons of rank. In another sense it is nearly synonymous with the term hospital, and is applied to buildings set apart for the reception of sick and infirm paupers; as the Hôtel de Dieu, Hôtel de Invalides.—*Ref.* Brande's *Dictionary*.

HOTHOUSE, *hot'-house* (Sax. *hat*, hot; *hus*, house), a term applied, in Hort., to a building constructed in a garden, or elsewhere, and warmed by artificial means, for the purpose of rearing exotics and other tender plants, which require more heat than our climate affords. Mr. London, in his "Encyclopædia of Gardening," observes,—"The imitation of warm climates by hothouses must not be confounded with the art of forcing the vegetables of temperate climates into the premature production of their flowers or fruits. The former was the first object for which hothouses were erected; and conservatories, greenhouses, and plant-stoves existed in this country before any description of forcing-houses; even pineries are of subsequent introduction to botanic and ornamental hothouses. The various climates and constitutions of plants require atmospheres of different degrees of temperature and moisture." The three great principles on which the construction of hothouses naturally depends, are *heat*, *moisture*, and *light*. With regard to the first consideration, heat, the structure must provide enough of this article to raise the internal temperature of the building from that of the lowest degree of the exterior atmosphere of this climate to that of the highest which prevails for any length of time in the country of which the plants to be introduced into the hothouse are natives. Moisture, to arrive at our second consideration, is more difficult to maintain in the hothouse than heat, and it is vitally necessary to the plants that an adequate supply of it should at all times be present in the atmosphere of the building. It follows, therefore, that that mode of heating is best which admits of the greatest quantity of vapour remaining uncondensed in the atmosphere of the hothouse. Thirdly, light cannot be admitted too copiously into these structures, and the transparent medium through which it enters should be such as reflects the greatest proportion of the sun's rays, which impinge obliquely on its surface. Hot water has now superseded the old method of heating by dry flues, and by this improvement, the distribution of heat can be better regulated, and the uniformity of temperature better maintained, than by any other known means. Ventilation should also be so provided for in hothouses, that it may be sufficiently effective in preventing excess of heat, while, at the same time, it is perfectly at command, so as to be employed, when requisite, in the most limited degree. (*See* CONSERVATORY, FORCING, GREENHOUSE, HORTICULTURE.)

HOUND, *hownd* (Sax. *hund*), a name applied generally to different dogs used in hunting and other field sports. The characteristic of a hound is its long pendulous ears. The bloodhound would appear to be the origin of all the other sub-varieties, which are mentioned in this work under their different names. England, not only from her climate, but also on account of the great care bestowed in the breeding and management of these animals, excels all other countries in her different breeds of hounds. (*See* BLOODHOUND, FOXHOUND, GREYHOUND, HARRIER, STAGHOUND, &c. &c.)

HOUR, *owr* (Fr. *heure*, Lat. *hora*), the name given to the twenty-fourth part of the space of time that elapses between two successive periods of midnight or midday, or the time during which the earth completes an entire revolution about its axis, and in which a complete apparent revolution of the sun through the heavens is effected. An hour, in angular measurement, is equivalent to 15 degrees of space, being the twenty-fourth part of 360 degrees. Thus the sun rises nearly an hour earlier at Prague, in Bohemia, than it does at London, because the former is nearly 15 degrees to the eastward of the latter. The hour is subdivided into 60 minutes in time, and each minute into 60 seconds.

HOUR CIRCLE.—The meridian of any place, or any great circle of the globe passing through the poles, is so called, because the hour of the day at any place can be ascertained, when the great circle on which the sun happens to be at that time is known.

HOUR-GLASS, *owr'-glâss*, an instrument which measures the passage of time by the running of fine sand from one glass vessel to another, through a very minute aperture. Instead of sand, dry egg-shells powdered are sometimes used. The quantity of sand is so proportioned as to measure different spaces of time; as an hour, half-hour, quarter, or minute; the last-mentioned being generally used at sea when "heaving the log," to ascertain the speed of the ship.

HOURIS, *how'-rees*, according to the Koran, virgins who are promised as one of the rewards of the blessed in Mahomet's paradise. From the description given in the book on which the Mohammedan faith is grounded, it appears that the *houris* surpass both pearls and rubies in their dazzling beauty: they are subject to no impurity; are always represented with dark eyes concealed by long jet eyelashes, the languishing glances of which they reserve for the voluptuous enjoyment of "true believers" alone. They are not created of clay like mortal women, but of pure musk, and are endowed with immortal youth, and every intellectual and corporeal charm. They dwell in green gardens, which are beautiful beyond what imagination can conceive, and they are always reclining on green cushions placed in fragrant bowers, where they await the advent of their possessors into Paradise. The name houris is derived from the Arabic *hûr al oyûn*, signifying *blackeyed*. Mahomet omitted nothing to render his heaven enjoyable to his disciples; and here he followed the traditions of the Hindoo religion, among which there is one concerning the paradise, called *behisht* and *menou*, which was furnished with *hurani beshisht*, or *blackeyed nymphs*, endowed with similar attractions to those which the houris possess.

HOUSE, *howse* (Ang.-Sax.).—In the widest acceptation of this term, it may be applied to any erection calculated to afford shelter to man or cattle, or protection to goods and stores; but in a more restricted sense, it is confined to the dwellings in which the middle classes of English society reside, in contradistinction to the more extensive palace, castle, or mansion, of the titled and wealthy on the one hand, and the little cottage of the artisan and labouring man, on the other. The first form of the house, considered generally as a dwelling, may be found in the conical huts and wigwams constructed by uncivilized nations. These consist chiefly of a simple framework of sticks, tied tightly together at the top, and covered with various materials, in accordance with the climate of the country in which they are erected. When implements and tools fit for hewing and shaping timber, and working stone, had been brought into use, and men had attained a degree of semi-civilization, the buildings that they reared were most probably somewhat similar to the rude block-houses formed by settlers in the colonies, and in the back woods of America, from which the transition to more durable abodes, built of brick and stone, but still of one story only in height, and covered with thatch supported on an inclined framework, would be rapid. The houses of the ancient Egyptians, and those of all eastern nations, in the early ages of the world, consisted of a series of contiguous apartments, opening into a central court, that was frequently adorned with shrubs and a fountain in the centre, and always separated from the street by a high blank wall with a single door in it, for the purpose of affording the means of ingress and egress to the inmates. The walls were built of sun-dried bricks, plastered over with stucco; the windows were small, the heat, rain, and wind being excluded by wooden shutters that moved on hinges; the floors were paved with stone, or formed of cement; and the roof, which was often used as a terrace on which the occupants of the building were accustomed to sit and walk in the cool of the morning

and evening, and even sleep during the sultry nights of summer, was flat, being formed of tiles and earth, supported on beams of timber, and of sufficient thickness to prevent the entrance of the rain. (*See* ASSYRIAN ARCHITECTURE.) When the house was two stories in height, the upper rooms were used as sitting-rooms and bedrooms, while the lower ones served as receptacles for grain and stores. The houses of the Greeks and Romans were built on a similar plan. In Greece, the dwelling-house was situated at the lower end of court, which was entered from the street through passage, on either side of which were stables and offices. It was generally two stories in height, the women occupying the upper rooms, and the men those on the ground floor. On this floor large chambers were also formed, one of which served as a work-room for the female part of the household, and the other as a common dining-hall. Round this hall, and opening into it, were apartments which were devoted to the accommodation of guests and strangers. The general arrangement of the houses of the Romans is described in the following page. (*See* HOUSE, ROMAN.) The method of construction adopted by the Greeks and Romans, the main feature of which was a central court with chambers opening into it on every side, was followed, with a few modifications, in all European countries during the middle ages. Entrance into an inner quadrangle was afforded by a large arched gateway in one of the sides; the parlours, kitchens, and living-rooms being placed round this square court on the ground floor, and the sleeping-rooms on the floor above, all opening into a cloister, or gallery, as in the *Tabard*, an old English hostel described by Chaucer in the "Canterbury Tales." In the houses of the mediæval period, the walls of the basement story were strongly built, to afford protection to the inmates against the attacks of robbers and personal foes. The shop and store-rooms, and sometimes the stables of the owner of the house, were to be found on this floor. The principal apartments were situated on the floor immediately above, to which access was gained by a small winding staircase, lighted by narrow windows in the wall, which could be defended by a single resolute swordsman against a score of hostile visitants. In France, Scotland, and Belgium, the houses were often many stories in height, and of great size. The roofs were high and steep, and a picturesque character was given to many of these old buildings by the peaked gables, which were often richly adorned by carved woodwork. Another peculiar feature in mediæval houses, that may be seen in Chester, Dartmouth, and other English towns possessing buildings of some antiquity, was the projection of one floor over that which was immediately below it; so that in a street in which the houses were of considerable height, the upper stories of the buildings on either side were only a few feet apart. There were no ceilings; the floors were generally dirty, even in houses that were occupied by the nobility and the higher classes; and the rooms were dark, the light being admitted through pieces of horn, or small diamond-shaped panes of ill-made glass, defective in transparency and commonly of a greenish hue. Although the houses of Italy, Holland, Belgium, and Flanders, that were built during the 12th and 13th centuries, are frequently marked by great architectural beauty externally, yet little improvement was made in domestic architecture in England, especially in the interior arrangements, until the reign of Elizabeth, when the architects of the day began to construct dwelling-houses with some regard to the locality in which they were situated, and the purposes for which they were specially required, and also in accordance with the tastes, habits, and pursuits of the persons for whom they were erected. (*See* ELIZABETHAN ARCHITECTURE.) The houses of the 18th century, consisting chiefly of large square piles of red brick, pierced with numerous windows in front and at the back, with a porch over the entrance, and a heavy slated roof projecting beyond the face of the walls, and supported by a bold but simple cornice, were roomy and comfortable, if not picturesque and ornate in appearance; but those of the Victorian age exhibit examples in which external elegance of structure is combined with judiciously contrived internal arrangements that tend to the comfort and convenience of the occupants in every respect. Practical details respecting house-building, and matters in immediate connection with it, are given elsewhere. (*See* BUILDING, DOMESTIC ARCHITECTURE, BRICKWORK, &c.)

HOUSEBREAKING. (*See* BURGLARY.)

HOUSEHOLD TROOPS, *house'-hold*, that part of the British army which is distinguished as the Guards, or Household Troops, consists of three regiments of cavalry and three of infantry. Although they were originally raised as a body-guard for the sovereign, and a portion of them is always on duty in the vicinity of the residence of the queen at Windsor and in London, they have seen as much active service abroad as any regiment in the service. The three regiments of cavalry are called the 1st and 2nd regiments of Life Guards, and the Horse Guards, or Oxford Blues; and the three regiments of infantry are termed the 1st, or Grenadier Guards; the 2nd, or Coldstream Guards; and the 3rd, or Scots Fusilier Guards. The origin of the 1st and 2nd Life Guards is found in a body of eighty cavalier gentlemen who were enrolled as a corps, under the name of "Life Guards," for the protection of Charles II. against the attempts of the fanatics of the republican party, and the reckless and desperate Fifth-monarchy men, who openly avowed their intention of assassinating him. It was not, however, until June 25, 1788, that the 1st and 2nd regiments of Life Guards were embodied under this title by George III., being formed out of four troops of horse, two of which had been previously distinguished as Horse Grenadier Guards, and the remaining two as Life Guards. The Horse Guards, or Oxford Blues, as they were called to distinguish them from the Dutch guards introduced by William III., that were equipped in uniform of a similar colour, were originally raised in the time of the Commonwealth, as a body-guard for Oliver Cromwell, and were continued after his death as a guard to the parliament, and to General Monk when he became lord-general of the kingdom. Of the foot guards, the 1st, or Grenadier Guards, is first mentioned as a part of the British army, under the name of the 1st regiment of Foot Guards, in 1662. It originally consisted of a number of royalist gentlemen, who were enrolled as a regiment for service in Spain under the duke of York, afterwards James II., in 1657. It was not distinguished as the Grenadier Guards until after the battle of Waterloo, when the regiment was so styled in consequence of its having defeated the grenadiers of the French imperial guard in that battle. The Coldstream Guards were General Monk's own regiment of infantry, that had served under him during the civil war and the time of the Commonwealth, and which he had recruited and reorganised at Coldstream, small town on the borders of Scotland, during his sojourn there in 1659, prior to marching thence to London to bring about the restoration of Charles II. to the throne of his ancestors. The Scots Fusilier Guards were probably embodied as a regiment at the same time as the Scots Life Guards, which were subsequently amalgamated with the English household cavalry. One troop of the Scots Life Guards were raised in Edinburgh, shortly after the accession of Charles II., to enforce episcopacy in Scotland, and to act as a guard to the Scottish parliament and the representatives of the king in Edinburgh. The regiment is first mentioned as a part of the British army in 1686; but it was not put on an equal footing with the 1st Foot Guards and Coldstream Guards until the union of England and Scotland in 1707. The value of commission in the household troops is considerably more than that of a commission in the cavalry and infantry of the line; and officers of the Guards have the privilege of holding that rank in the army which is immediately above the grade which they occupy in their own regiments; an ensign in the Guards being styled lieutenant and ensign in his commission; and so on. The uniform of the Life Guards consists of a scarlet tunic, white breeches, and jack boots, with a polished steel corselet and helmet, with a white plume. The Horse Guards wear a blue tunic, and a red plume in the helmet, but are similar to the Life Guards in other respects. The Foot Guards wear scarlet with blue facings, and bearskins when in full dress. The regiments are distinguished by the

ornaments on the collar of the tunic,—the Grenadiers wearing a shell, the Coldstreams St. George's cross in red on a white field, and the Scots Fusiliers St. Andrew's cross, also in red on a white field. The soldiers of the different regiments may also be distinguished, when in undress, by the band worn round the cap; that worn by the Grenadier Guards being red, that of the Coldstream Guards white, and that of the Scots Fusiliers red and white cheque. The Life Guards and Horse Guards are armed with rifled carbines and swords, and the Foot Guards with the long Enfield rifle and bayonet.—*Ref.* Rafter's *Guards, or Household Troops of England.*

HOUSE-JOINING. (*See* JOINERY.)

HOUSE OF CORRECTION. (*See* PRISON.)

HOUSE, ROMAN.—The houses of the poorer classes in Rome were extremely simple in structure and plain in appearance. It is said that they were exactly the same in every respect in the later days of the empire as they were when the republic was established. They were built of earth and unbaked bricks, and were thatched with straw or reeds. They were not more than a single story in height, and an old drawing of a Roman cottage, a copy of which is given in Mazois' "Ruines de Pompéi," represents them as being circular in form, with a wide doorway in front, and an overhanging roof not unlike a mushroom in shape. The houses of the wealthy Romans, which were built of marble, and richly adorned with paintings and sculpture, exhibited a striking contrast to the hovels of the poorer citizens—"*pauperum tabernas*," as they are termed by Horace. Their general plan and character may be gathered from the houses that were discovered when excavations were made in 1755 and subsequent years on the site of the buried city of Pompeii, which was destroyed by an eruption of Mount Vesuvius in the year 79. A description of that which is known as the house of Pansa, which is more perfect than any other that has yet been cleared of the superincumbent mass of ashes and scoriæ, will serve to furnish some idea of the manner in which the best houses of Rome were constructed. That part of the house which faces the street is divided into a number of small shops of two stories in height, as it is supposed, which were let out for different purposes. A passage between two of the shops leads into an open court or *atrium* (*see* ATRIUM), which was surrounded on all sides with a covered gallery or cloister resembling a wide verandah. The servants' chambers, a summer dining-hall, or *tablinum*, and reception-rooms for the accommodation of persons who desired to see the owner of the mansion on business, are ranged round this court, which contains a tank of water in the centre. A passage by the side of the summer dining-hall leads into an inner court, also surrounded by a covered gallery, the roof of which was also supported on columns, and round which were placed the picture-gallery, the private dining-room, or *triclinium*, and the private apartments of the family.

HOWITZER, *how'-itz-er* (Ger. *haubitze*, from *häufen*, to fill), a kind of gun, from which large shot and shell may be thrown at short ranges. These guns are constructed in brass and iron. Brass howitzers form part of a field battery, and are used for firing shell to clear a village, or any similar position that it is necessary to occupy. They vary in length from 2 feet to 4 feet 9 inches, and will throw 4½-inch and 5½-inch shells. Iron howitzers, from 4 to 5 feet in length, which throw 8-inch and 10-inch shells, are used in sieges, especially for ricochet firing. Howitzers are longer than mortars, and shorter than guns of the same calibre; they require a small charge of powder, but the angle of elevation at which they are fired is high. They were first used in the British service about the end of the 17th century.

HOY, *hoy*, a small vessel, usually rigged as a sloop, and employed on the sea-coast for the transport of both passengers and goods. The marks of distinction between this vessel and some others of the same size cannot be easily described, as those which are called *hoys* in one place would be termed *sloops* or *smacks* in another; indeed, even those who navigate these vessels are said to have very vague notions of their distinguishing marks.

HUDSON'S BAY COMPANY, *hud'-sons*, a company established for carrying on the fur-trade, to which Charles II., in 1670, granted a charter, empowering it to trade exclusively with the aborigines in and about Hudson's Bay. Prince Rupert was at the head of the Hudson's Bay Company, and as the fur-trade was then very lucrative, the association soon rose to prosperity. In the winter of 1783, a new company, calling itself the North-west Fur Company, was established at Montreal, and actively opposed the Hudson's Bay Company. The earl of Selkirk was then at the head of the old company, and conceived the plan of establishing a colony on the Red River of Lake Winnipeg. The North-west Company was jealous of this movement; and in consequence of the evil feelings arising out of opposing interests, a war broke out between the servants of the two companies. In this calamitous affair, many outrages and much barbarity were displayed. However, the companies wearied of the strife at last, and united under the name of the Hudson's Bay Fur Company, which at the present time engrosses most of the fur-trade of British America. The new company established factories and settlements in various parts; on the south, chiefly on the west coast of Labrador, in the countries inclosing James's Bay, and along the banks of Albany river. The principal settlements in the north are on Hayes river and on Mackenzie river. There are numerous mart-houses, besides these factories, dispersed in all directions for upwards of a thousand miles in the interior, to which the natives bring furs, skins, feathers, &c., in exchange for cloths, blankets, trinkets, &c.

HUE-AND-CRY, *hu-ând-kri* (Fr. *huer*, to shout; *crier*, to cry aloud), in Law, a custom of ancient origin, and the common process employed in the pursuit of a felon or offender. It is a form of procedure that may be had recourse to by a person who has been robbed, or otherwise injured, to obtain possession of the culprit's person. Any individual, whether he is a constable, peace-officer, or private man, may concur in the pursuit raised upon a hue-and-cry, and may be justified in the apprehension of the party pursued, even though it should transpire that he is innocent, or that no felony has been committed. If a pursued party take refuge in a house, to which admission has been refused, the door may be broken open to secure him. If, however, a person wantonly and maliciously raise a hue-and-cry without cause, he is liable to fine and imprisonment, as well as to an action at the suit of the party injured. Although the term has, in a great degree, fallen into disuse, the process is still acknowledged by the English law, which allows that a hue-and-cry may be raised by a precept of a justice of the peace, and even by a private person, in the absence of the constable; but should the latter be accessible, it is the duty of the individual to make known to him the circumstances of the felony and the person of the culprit.—*Ref.* Wharton's *Law Lexicon*; *English Cyclopædia*—Arts and Sciences.

HUGUEN[illegible], *hu'-ge-nots*, a term of contempt formerly applied in [illegible]rance to the early followers of Luther and Calvin. [illegible] origin of the word is uncertain; but it is stated [illegible] derived from *eidgenossen*, 'bound together b[illegible] term borrowed from the motto of the con[illegible]antons of Switzerland by certain inhabita[illegible]eva, who were among the earliest [illegible]ned notions upon religion into [illegible] has now fallen into disuse in the French [illegible] followers of Calvin being called Réformés, [illegible] disciples of Luther are included, together wi[illegible]rmer, under the generic appellation of Prot[illegible] The history of the rise and progress of the H[illegible] forms one of the chief chapters in the annals o[illegible]. For some time after their establishment as a [illegible] the Huguenots continued to increase in numbers, although they were troubled with occasional persecutions under the reigns of Francis I. and Henry II., until the year 1560, when they took part in the conspiracy of Amboise. By the edict of January, 1562, the right of free exercise of their religion was restored to them; but in truth this edict was worthless to them, and they were forced to rise *en masse* to save themselves from the persecutions of the government. The leaders were the Prince de Condé, Admiral Coligny; and, indeed, they numbered

amongst them some of the noblest and most influential houses in France. Although thus powerful, the wars of the 16th century soon decimated them, and they gradually lost ground under the continual aggressions of the Catholic body. After the conversion, or perversion, of Henry IV., most of the nobles abandoned the failing cause of the Huguenots. They, however, managed to sustain two civil wars against Louis XIII. in the following century. The history of the Protestant church in France then ceased to have any political bearing, and the name Huguenot itself soon passed out of ordinary use.

Hulk, *hulk* (Sax. *hulc*), a term applied to any old vessel which has been stripped of her masts, rigging, &c., and laid by as unfit for sea-service. They are employed for such uses as the raising sand or ballast, &c., or for accommodating a ship's company while their own vessel is under repair.

Hull, *hull* (Sax. *hul*).—The hull of a ship is her frame or body, exclusive of the masts, yards, sails, or rigging. The term is usually applied to vessels either before they have been rigged, &c., or after they have been stripped and dismantled.

Humanities, *hu-măn'-e-tees*, a term employed in modern European schools and colleges to signify polite literature, or grammar, rhetoric, and poetry, including the study of the ancient classics. The term is employed in opposition to philosophy and science. In a more restricted sense, it is used for philology. *Humanitas*, in classical Latin, has the secondary sense of erudition, learning; and *studia humaniora* is used by modern writers to signify belles-lettres, or elegant literature.

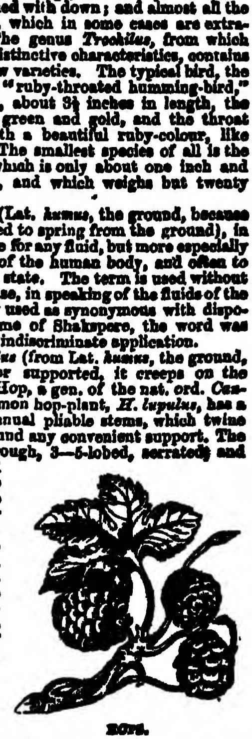
Humerus, *hu'-me-rus* (Lat.), a term in Surg., applied to the bone of the arm. It constitutes the first of the radiated system of bones of the anterior extremity in vertebrated animals, articulated with the scapula.

Humiriaceæ, *hu-me-re-ai'-se-e*, in Bot., the *Humirium* fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, consisting of three genera and 18 species, all natives of tropical America. They are trees, or shrubs, with a balsamic juice. Their leaves are alternate, simple, coriaceous, and exstipulate. The calyx is 5-parted and imbricated. The petals are also imbricated, and 5 in number. There are 20 or more stamens, hypogynous and monadelphous; the anthers are 2-celled; the connective is elongated beyond the anther lobes. The ovary, which is superior, is usually surrounded by a disc; it is 5-celled, and has 1 or 2 suspended ovules in each cell, a simple style, and 5-lobed stigma. The fruit is drupaceous and 5-celled, except in instances where the number of cells is reduced by abortion. The seed has a narrow embryo, lying in fleshy albumen. From the incised stem of the species *Humirium floribundum*, a yellow liquid, called balsam of umiri, is obtained: this is said to resemble copaiba and balsam of Peru in its properties. Other species are said to yield useful balsamic liquids.

Humming-birds, or Trochilidæ, *hum'-ming*, a family belonging to the tenuirostral tribe of the order *Passeres*. This family contains a great number of species, above 300 having been described, and they have been divided into many genera and sub-genera; in the last ornithological catalogue, amounting to no less than 76. The *Trochilidæ* include some of the smallest known birds, many of which are remarkable for the wonderful splendour of their plumage. In this one respect alone, neither pen nor pencil could convey any adequate idea of their dazzling lustre. They are active little birds, and from the structure of their frames, it is apparent that they were intended to pass most of their time on the wing. Their food consists of small insects, and perhaps the nectareous juices of flowers, which their tongue is beautifully fashioned for obtaining. This organ is very long, and can be darted out of the bill to a considerable length, by a sudden motion, like that of a spring. Their feet are small, generally dark-coloured, and in several species which live high up in mountainous regions, the tarsi are warmly protected with large white plumelets, giving them the appearance of having downy muffs on their legs. Their wings are very long and narrow, and they are, by means of the rapid motion given to them, able to balance themselves in the air, hovering round flowering shrubs and plants, probing their tubular nectaries, and at the same time emitting a pretty loud humming noise, caused by the concussion of their wings with the air; whence their English name "humming-birds." The *Trochilidæ* are very pugnacious little creatures, and defend their nests with the greatest courage against all intruders, even man himself. They are exclusively seen in the New World, of which they are natives; the Spaniards having first made us acquainted with them, from their invasion of Mexico. They are found from one extent of the vast continent of America to another, though in greatest abundance in the tropical parts, in the deltas, and along the banks of the great rivers both of the North and South. Humming-birds are also found in great abundance in the West-India islands, where, also, some species may be seen which do not occur on the mainland. One of these in particular, termed the *Mellisuga humilis*, has a very sweet note, and is perhaps the only species of the family that has a real song. The male bird of this variety is about 2½ inches in length, and is exactly like an humble bee when darting about in the air. The nests of the humming-birds are wonderfully made with cotton, wool, and twigs, beautifully interwoven with feathers, and lined with down; and almost all the species lay two eggs, which in some cases are extraordinarily small. The genus *Trochilus*, from which the family takes its distinctive characteristics, contains but comparatively few varieties. The typical bird, the *Trochilus colubris*, or "ruby-throated humming-bird," is a beautiful species, about 3½ inches in length, the body glittering with green and gold, and the throat and chin glowing with a beautiful ruby-colour, like that of a live coal. The smallest species of all is the *Mellisuga minima*, which is only about one inch and a quarter in length, and which weighs but twenty grains.

Humour, *hu'-mor* (Lat. *humus*, the ground, because moisture was supposed to spring from the ground), in Surg., a general name for any fluid, but more especially applied to the fluids of the human body, and often to these in their morbid state. The term is used without any reference to disease, in speaking of the fluids of the eye. It is frequently used as synonymous with disposition, and in the time of Shakspere, the word was greatly abused by an indiscriminate application.

Humulus, *hu'-mu-lus* (from Lat. *humus*, the ground, as, unless trained or supported, it creeps on the earth), in Bot., the Hop, a gen. of the nat. ord. *Cannabinaceæ*. The common hop-plant, *H. lupulus*, has a perennial root and annual pliable stems, which twine from right to left around any convenient support. The leaves are opposite, rough, 3—5-lobed, serrated, and veiny. The male and female flowers are generally on separate plants. The former are in loose panicles; the latter in dense catkins or strobiles, with membranous concave bracts. The hops of commerce consist of the female flowers and seeds of this plant. Their principal consumption is in the manufacture of beer, and they possess three properties which particularly fit them for this use.



HOPS.

First, they impart to malt liquors a pleasant bitter aromatic flavour and tonic properties. Second, they give them a peculiar *headiness*, often confounded with alcoholic strength, and thus save the brewer a certain proportion of his malt. Third, by their chemical influence they clarify the liquors and check their tendency to turn sour. Hop-plants grown from root-sets come to perfection in the third year from planting. They spring out of the ground about the end of April, and flower about the end of August. The strobiles are fit to gather from the beginning of September to the middle of October, the time varying according to the sort cultivated and the differences in the seasons. When picked, they are dried by artificial heat, in kilns, and then packed in bags or pockets.

Upon the bracts and scales are numerous little yellow shining grains, generally roundish or kidney-shaped. They have been termed *lupulinic glands*, and are believed to be the most active parts of the hops. Of the cultivated hop there are many varieties; but in the principal English hop counties,—Kent, Surrey, and Sussex, only about five varieties are extensively grown. These are thus described by Johnston:—"1. The *goldings*, grown chiefly in middle and east Kent. They delight in a rocky calcareous soil, or a rich friable loam. They thrive only in the most naturally fertile kinds of soil. 2. The *white-bines* are the favourites of Farnham and Canterbury. They require the same description of soil as the goldings, are very similar in their appearance and growth, and have nearly the same value in the market. The flower of the white-bines is considered to possess the most delicate flavour, while that of the goldings is thought by some brewers to have more strength. These two varieties are the most esteemed for the brewing of pale bitter ale. They both require very long poles, and on the average of years produce smaller crops than the coarser kind of hop. 3. The *Jones's* stand next in favour with the brewer. They will grow on inferior land; and as they require very short poles, and are pretty good croppers, they are in general favour with many growers in Kent. 4. The *grape* has many sub-varieties, and requires longer poles than the Jones's. This variety delights in stiff heavy soils, after thorough drainage, and produces very heavy crops. Hence its prevalence in the Weald. It is commonly used for the ordinary sorts of beer. 5. The *Colegate* is a smaller variety of hop than the grape, but produces enormous crops in Sussex and the Weald of Kent. It is often surreptitiously passed off in the market as goldings; but it is greatly disliked by the brewers on account of the rankness of its flavour." The hops of Retford, in Nottinghamshire, are known in the market as *north clays*; they are said to be pre-eminent in rankness. The Worcester hops, grown on the red soils of the vale of the Severn, are, on the other hand, remarkable for their mild flavour; in this respect, indeed, they excel the Kent goldings. The Lancashire beer-drinker, who has acquired a taste for Worcester hops, does not relish beer hopped with Kentish, and contemptuously styles it "porter-ale." Worcester hops do not answer, however, for the best descriptions of pale ale, because they do not impart so fully the keeping quality. From fifty to sixty millions of pounds of hops have, of late years, been consumed annually in the United Kingdom. Hops are used medicinally for their stomachic and tonic properties. They are, to some extent, narcotic; and a pillow stuffed with them is occasionally employed to induce sleep. (*See* ALE, BREWING.)

HUNDRED, *hun'-dred* (Ang.-Sax.), a part or division of a shire; so called, either because, of old, each hundred found 100 fide-jussors or sureties of the king's peace, or 100 able-bodied men for his wars. By others it is supposed that the hundred originally consisted of 100 families. It seems, however, probable that the term had different significations in different parts of the country. Hundreds were first introduced into England by Alfred, king of the West Saxons. Divisions of a similar kind seem to have existed before in Denmark; and in France a regulation of a similar sort was made 200 years before, by Clothaire and Childebert, with the view of making each district answerable for the crimes therein committed. An institution very similar to that of the hundreds may be traced back to the ancient Germans, from whom were derived the Franks, who became masters of Gaul, and the Saxons, who settled in England. To each English hundred belonged a court. (*See* COURT OF THE HUNDRED.) As a convenient method of reference, the division into hundreds is frequently made use of in acts of parliament.

HUNDRED-WEIGHT, one of the terms of Avoirdupois weight, and generally expressed by the abbreviation *cwt.* A hundred-weight contains 112 lbs., and is subdivided into 4 quarters, each, of course, containing 28 lbs.

HUNGER, *hung'-ger* (Sax.), a peculiar sensation experienced in the regions of the stomach, in consequence of the want of solid food. The sensation of hunger is at first rather agreeable, but it quickly becomes unpleasant, when prolonged. The sense of keen appetite is always delightful when there is a prospect of satisfying it; but that sinking in the stomach which ensues, soon changes from uneasiness to absolute pain, which rapidly becomes acute; and if aliment be still held back, the sensation produced is as if the stomach were being torn by pincers. A state of general exhaustion, feverishness, headache, light-headedness, often passing into madness, follows. The whole being seems absorbed in one desire, before which even maternal instinct has been known to give way, and mothers have disputed with their companions for the flesh of their dead infants. The physiological causes of hunger are not well understood, and great differences exist in the opinion of scientific men. In one sense, we may all be said to know what hunger is; in another sense, however, no man can enlighten us. We have all experienced it; but as yet science has been unable to furnish any sufficient explanations. Between the agreeable stimulus called appetite and the terrible agony of starvation there are infinite gradations. In all living organisms, *waste* and *repair* go on with an incessant and reciprocal activity. Not the slightest movement of the body occurs, not a thought passes through the brain, without some part of the substance of the body being sacrificed. Thus the body is like a furnace, in which the fuel is constantly burning; and hunger is the instinct which teaches us to replenish that furnace. But although the want of food causes hunger, it does not itself constitute hunger. Food may be absent without the sensation of hunger. Idiots and insane people frequently subject themselves to prolonged fasting without any hungry cravings. Violent emotions of grief or joy destroy the sense of hunger; and the sensation may be allayed by opium, tobacco, and even inorganic substances, such as clay, although none of these can supply the deficiency of food. In the case of those animals which remain torpid for a certain portion of the year, no food is taken, and no hunger experienced. (*See* HYBERNATION.) Want of food is, consequently, the primary, but not the proximate cause of hunger. A French philosopher made several experiments on the subject of inanition, according to which it appears that death from hunger occurs when the waste reaches 0·4; that is to say, supposing an animal to weigh 100 lbs., it will die when its weight is reduced by fasting to 60 lbs. Death may possibly occur before that stage, but life cannot exist after it. In the case of human beings, death arrives on the fifth or sixth day of total abstinence from food and drink; but much depends upon the peculiar constitution of the individual, his age, health, habits, &c. Some die on the second and third days; while others can survive ten, twelve, and even sixteen days! There are many records of protracted fasting, but nearly all of them are not well authenticated, and most of them are obviously fabulous. The aspect of a starving man is terrible. In the first place he grows excessively thin, and this thinness is not the leanness of lean men, but manifests itself by unmistakable emaciation. The face grows lividly pale, the cheeks sunken, and all the vitality of the body seems to be centred in the feverish brightness of the eyes. The pupil becomes dilated and fixed in a wild stare, which is never veiled by the eyelids. All movements of the body are slow and difficult; the hand trembles, the voice grows feeble, and the mind we[illegible] while the poor sufferer, when asked what he feels, can only answer faintly that he is hungry. There is very little definite information to be gleaned concerning the agonies endured by starving men. Those who have undergone the horrors are seldom able to recount them. Goldsmith says that the captain of a wrecked vessel told him that "he was the only person who had not lost his senses when they received accidental relief. He assured me his pains at first were often so great as to be often tempted to eat a part of the men who died, and which the rest of his crew actually lived upon. He said that, during the continuance of this paroxysm, he found his pains insupportable, and was desirous, at one time, of anticipating that death which he thought was inevitable. But his pains gradually ceased after the *sixth* day (for they had water in the ship, which kept them alive so long), and then he was in a state rather of languor

than desire; nor did he much wish for food, except when he saw others eating. The latter part of the time, when his health was almost destroyed, a thousand strange images rose upon his mind, and every one of his senses began to bring him wrong information. When he was presented with food by the ship's company that took him up, he could not help looking at it with loathing, instead of desire; and it was not till after four days that his stomach was brought to its natural tone, when the violence of his appetite returned with a sort of canine eagerness." In other authentic cases, one fact is always dreadfully apparent; namely, that thirst is always far more terrible than hunger. (*See* THIRST.) According to popular belief, the sensation of hunger is caused by the emptiness of the stomach, which, in the opinion of some physiologists, allows the sides of the stomach to rub against each other, and the friction causes the sensation. This, however, is wrong, for hunger is always felt some time after the stomach is empty; and, as is well known, it may be empty for days together, as in illness, without any sensation of hunger. Another theory is that the gastric juice accumulates, and attacks the walls of the stomach. This, however, has been proved not to be the case. Dr. Beaumont, in America, who made many valuable observations on a patient who had a hole in his stomach, produced by a wound, accounts for hunger thus:—"During the hours of fasting, the gastric juice is being slowly secreted in the follicles, and retained in their tubes, thereby distending them; this distension, when moderate, produces the sensation of appetite, and when more powerful, of hunger." According to other writers, however, it would appear that hunger is related to the general state of the system, and also to the particular state of the stomach. The stomach of a fasting animal is pale, and in a state of obvious *atony*. No sooner, however, is food, or almost any irritant substance introduced, than the pale surface becomes visibly congested, turgescent, and its secretions pour forth abundantly. With this rush of blood, the sensation of hunger passes away. It is therefore argued that hunger is in some way dependent on the state of the circulation of the stomach.—Ref. *Blackwood's Magazine*, January, 1858,—Hunger and Thirst.

HUNS, and HUNNI, *hunz*, *hun'-ni*, names given by historians to several nomadic Scythian tribes, which devastated the Roman empire in the 5th century. They inhabited the plains of Tartary, near the boundaries of China, it would appear, many centuries before the Christian era; and they were known to the Chinese by the name of Hiongnu, and also Han. It was in order to put a stop to the continual aggressions of the Huns that the great wall of China was built; and after this the Huns split up into two separate nations, named respectively the Northern and the Southern Huns. The first-mentioned of these gradually went eastward to the Volga, where they encountered the Alanni, whom they defeated. Here the Huns remained for some two centuries; but, under the emperor Valens, they crossed the Bosphorus; afterwards invading Rome, under their leader Attila. After the death of Attila, the Huns broke up into separate tribes, and were driven back by the Goths beyond the Tanais. The Hungarians of the present day are the descendants of Huns, who once more immigrated into Europe. Gibbon, in his "Decline and Fall of the Roman Empire," gives a fine sketch of this nation, their manners and customs.

HUNTING, *hunt'-ing* (from Sax. *huntian*, to hunt), a favourite British sport, which seems to have been pursued even in the earliest times. The classics have many and full accounts as to the hunting of wild animals for pleasure; but the fox-hunting of the present day eclipses, in its hardihood and naive recklessness, all the chases which were prosecuted both by the Greeks and Romans. As leaping is incidental to hunting, being one of the paces of the horse, it had best be here described. The act of leaping "is performed by a sudden extension of all the articulations of the hinder extremities, immediately after they have undergone an unusual degree of flexion. This extension, communicating its impulse to the centre of gravity of the body, the whole is projected forward with a velocity determined by the force applied and the weight of the mass. The degree of projectile force depends on the proportional length and obliquity of the angles formed by the bones, and on the strength of the muscles which act on them; hence becomes apparent what has before been insisted on,—the necessity that hunters, as well as racers, should be so formed behind as at once to unite great strength with length. Nevertheless, it does not necessarily follow that a large horse only can take considerable leaps; for, *cæteris paribus*, small animals leap proportionately farther than large ones; for the projectile force impressed on two bodies being in proportion to their different magnitudes, their velocities will be equal, and the extent of the space through which they pass will necessarily depend upon their respective velocities. Thus a small horse with a light weight will frequently leap very considerable distances, and to a very considerable height; but from the greater extent of the angles, and the increased force obtained from larger muscles, it is obvious that a certain size is necessary to the hunter to cover high and wide leaps; and the necessity is also increased if much weight is to be carried. The direction of a leap depends on the situation of the centre of gravity with respect to the limbs by which the impulse is given: men and birds, having the trunk situated immediately over the impelling limbs, are the only animals that leap vertically. Hence, when a horse attempts a standing leap of considerable height, as a wall, high gate, &c., he raises himself almost perpendicularly, and the elevation of his body will always be found correspondent to the height of the object he is to leap over."—(Blaine's *Encyclopædia of Rural Sports*.) The hunter is trained nearly in a similar manner to the racer (*see* HORSE-RACING), with this alteration, that the object with the latter is to "keep the length in him," or, in other words, to insure a burst of speed when called upon; while the former is trained to exhibit stoutness and increased endurance, with a proportionately less degree of speed. The *seat* in the hunting-saddle stands next to that of the jockey in importance, as on it depends the whole success of the fox-hunter. He must not only be firm in the saddle, in order to prevent falling during the performance of the leaps which his horse takes, but must also so ride his hunter as to make the most of him, and not weary him out by holding him in too tightly, or working him unnecessarily. In an article on the subject in the "Encyclopædia Britannica," it is stated, that above all things he must acquire a firm, close, and *well-balanced* seat in his saddle, which is not merely necessary in leaping, but in galloping over every description of ground. A swagging seat in the last-mentioned act is sufficiently bad to make a great difference to a hunter in a severe chase; but when we picture a horse alighting on the ground, after having cleared a high fence, and his rider alighting two or three seconds after in his saddle, so far forward, perhaps, as to fall beyond the pillars of support, or backwards behind the centre of action, and the part (just behind the shoulders) which ought to form the junction between the rider and his horse, we can readily imagine how distressing it must be to him, and how much a large fence, so taken, must exhaust him, over and above what would be the case if he had had the assistance of a firm hand to support him on alighting; but which, however, with such a seat as described above, no man can possess. The first and chief requisite, therefore, for a person who follows hounds is the combination of a light hand with a firm seat, without which no one will ever be foremost in the field; and fortunate is it for his horse, as well as for himself, if he possess it to the degree required to constitute a fine horseman over a country. (The different varieties of dogs used in hunting will be found given under their respective names; as FOXHOUND, GREYHOUND, HARRIER, &c.) Hunting generally became an organized sport during the past century; and from the time that has elapsed from its introduction, many alterations have occurred in it. In old times stag-hunting was the true royal pastime, but now fox-hunting has usurped its place, and stag-hunting is now but comparatively rarely followed. A writer on the subject in the *Quarterly Review* observes:—"In no one instance has the modern varied from the ancient system of hunting more than in the hour of meeting in the morning. Our forefathers threw off the pack as soon as they could distinguish a stile from

a gate, or, in other words, as soon as they could see *ride* to the hounds. Then it was that the hare was *hunted to her form* (*see* HARE) *by the trail*, and the *fox to his kennel by the drag*. Slow as this system would now be deemed, it was a grand treat to the real sportsman. What, in the language of the chase, is termed the 'tender-nosed hound' had an opportunity of displaying himself, to the inexpressible delight of his master; and to the field (that is, to the sportsmen who joined in the diversion) the pleasures of the day were enhanced by the moments of anticipation produced by the drag. As the scent grew warmer, the certainty of finding was confirmed, the music of the pack is increased, and, the game being up, away went the hounds 'in a crash.' Both *trail* and *drag* are at present but little thought of; hounds merely draw over ground most likely to hold the game they are in quest of; and thus, in a great measure, rely upon chance in coming across it; for if a challenge be heard, it can only be inferred that a fox has been on foot in the night, the scent being seldom sufficient to enable the hound to carry it up to his kennel. Advantages, however, as far as sport is concerned, attend the present hour of meeting in the field. Independently of the misery of riding many miles in the dark, which sportsmen of the early part of the last century were obliged to do, the game, when it is now aroused, is in a better state to encounter the great speed of modern hands, having had time to digest the food which it has partaken of in the night, previously to its being started. But it is only since the great increase of hares and foxes, that the aid of the trail and drag could be dispensed with, without the frequent recurrence of blank days, which now seldom happen." There are many technical terms connected with hunting which must be well known by the would-be sportsman. With regard to the *tails* of animals, that of the fox is called its *brush*, that of the deer, its *single*; while the feet of a fox are called *pads*, its face, the *mask* or *front*, and that of a deer, its *snout* or *nose*. With regard to the *numbers* of dogs, "we say a *brace* of greyhounds, but a *couple* of hounds; a *leash* of the former, but a *couple-and-half* of the latter. In true sporting phraseology, it is a *kennel* of foxhounds, a *pack* being thought more appropriate to harriers; but many crack sportsmen are nevertheless heard to talk of a *pack* of foxhounds in common parlance." When it is observed that hounds, in drawing a cover, hit the scent the reverse way, they are said to *draw amiss*. When the game is up, and the hounds scent it in the opposite direction to that which it is taking, they are then said to *run to the heel*, or *run to counter*. When they take a fresh scent, i. e., go off on another trail to that on which they started, in consequence of the two scents crossing, they are said to *hunt change*. The terms *run mute* and *run riot* are also employed when they run without any cry, or are disobedient to the huntsman. In a fox-hunt, when the sportsmen are assembled, and the hounds enter the first cover, they are said to *throw off*, and when they carry the scent to a given point, and no longer stoop their noses to it, they are said to *throw up*. When the goodness of the scent enables the whole pack to *stream away* at the top of their speed, they often do not cry, or, in sporting phraseology, *throw a tongue*. When the hounds acknowledge the scent, however, by lifting their tongues freely, they are said to be in *full cry*. Every pack of hounds, besides the huntsman, should possess at least two *whippers-in*, one in order to turn the hounds when at fault, and the other to keep up those that are trailing off. The place where the hounds and sportsmen assemble is termed *the meet*. Every sportsman usually sends forward two hunters here, under charge of his groom, and he himself rides to cover on his hack. The advantage of having two horses consists in having a second to mount, should the run be long, and the first horse worn out. To foreigners, fox-hunting seems a most extraordinary hallucination on the part of Englishmen, that they should often risk their lives for the attainment of its paltry brush; but there is not any doubt that it was first instituted for the purpose of getting rid of the vermin which had been always the plague of the farmyard. Hare-hunting and coursing are not such hazardous sports as fox-hunting, and, consequently, are not much liked by sportsmen accustomed to the latter. With regard to hunting the stag, her majesty's stag-hounds meet during the season at Windsor; but as the game is usually park-bred or carted to the meet, not much dashing sport can be expected, like that which is met with in fox-hunting. (*See* STAGHOUND.)

HUON PINE. (*See* DACRYDIUM.)

HURRICANE, *hur'-re-kain* (Span. *huracan*), a most violent storm, generally accompanied by thunder and lightning, and distinguished from every other kind of tempest by the extreme violence of the wind, and by its sudden changes. Hurricanes occur most frequently in the East and West Indies, Mauritius, and some parts of China. The West-Indian hurricanes usually occur in the rainy season, during the month of August, and sometimes, but rarely, in July and September. It has been described as a sudden and violent storm of wind, rain, thunder, and lightning, attended with a furious swelling of the sea, and sometimes with an earthquake. The labour of many years is often destroyed by these storms; whole fields of sugar-cane are sometimes whirled into the air, and scattered over the face of the country; while the strongest forest trees are torn up by their roots and driven about like stubble. The houses of the inhabitants are no protection; for the roofs are blown off at one blast, while the rain, which rises five feet in an hour, rushes upon them with an irresistible violence. These hurricanes occur with very little warning; but the Indians know certain signs by which they can always prognosticate the coming tempest.

HUSBAND AND WIFE, *huz'-bănd* (Ang.-Sax.), in Law, are in many respects regarded as in peculiar circumstances, and particular laws are in force regarding them. For most purposes they are looked upon as only one person, the legal existence of the woman being hidden or incorporated in that of her husband; whence she is called a *feme covert*, and her condition during marriage, her *coverture*. For this reason a man cannot grant anything to his wife directly, nor enter into covenant with her; for the grant would be to suppose her separate existence, and to covenant with her would only be to covenant with himself; but a husband may grant to his wife, by means of a trustee or releasee to uses, and he may bequeath anything to his wife by will, seeing that that cannot take effect till the coverture is determined by his death. The husband is bound by law to provide his wife with necessaries as much as himself; and if she contract debts for them, he is bound to pay them; but for anything beyond necessaries he is not chargeable. If a wife elopes, and lives with another man, the husband is not chargeable, even for necessaries, at least if the person who furnishes them is sufficiently apprised of her elopement. If a wife be indebted before her marriage, the husband is bound to pay the debt, for he has adopted her and her circumstances together. If the wife be injured in her person or property, she can bring no action for redress without her husband's concurrence, and in his name, as well as her own; neither can she be sued without making the husband a defendant, except where he may have abjured the realm, or been banished; for then he is dead in law. In criminal prosecutions, however, the wife may be indicted and punished separately; for the union is only a civil one. In the ecclesiastical courts, also, a woman may sue and be sued without her hus-
...o in courts of equity, by means of what is ... friend, where the interests of the two are ... ugh in general the law considers man ... e person, yet there are some instances in ... rately considered as inferior to him, ... compulsion. Therefore, all deeds ex... done by her during her coverture, are void, except in execution of a power; in which case she must be solely and secretly examined, to learn if her act be voluntary. She cannot by will devise lands ... her husband, unless under special circumstances; ... at the time of making it she is supposed to be under coercion. In some felonies too, and other inferior crimes, committed by her through constraint of her husband, the law excuses her; but this does not extend to treason or murder. The law regards marriage in no other light than a civil contract, and as such, treats it as it does all other civil contracts; allowing it to be good and valid in all cases where the parties at the

time of making it were in the first place *willing* to contract; secondly, *able* to contract; and, lastly, actually *did* contract, in the proper forms and solemnities required by law. In general, all persons are able to contract marriage, unless they labour under some particular disabilities and incapacities. These are of two sorts: first, such as are canonical, and recognised by the ecclesiastical laws; as consanguinity, or relation by blood; affinity, or relation by marriage; precontract and certain particular corporal infirmities: and second such as are created or enforced by the municipal laws as a prior marriage, want of age, want of reason, &c. Lastly, in order to make a good legal marriage, it must be performed in due form of law. (As regards the dissolution of marriage, *see* DIVORCE.)

HUSBANDRY. (*See* AGRICULTURE.)

HUSSARS, *hus-sars'* (Hungarian *husz*, twenty; *ar*, pay), a term applied to certain well-known cavalry troops employed in all European armies. The name was first applied to the troops raised by the nobles of Hungary when Matthias Corvin made his appeal to them in 1458. Every twenty houses furnished one man to the troop,—hence the origin of the term. The modern hussar equipments are very light and elegant, and their arms consist of a sabre, a carbine, and a pair of pistols. There are at the present time thirteen regiments of hussars in the English army.

HUSSITES, *hus'-sites*, an appellation given to the followers of John Huss, the Bohemian reformer. The latter was condemned to be burnt alive along with his books, because he endeavoured to overthrow the Roman Catholic church; and the sentence was carried out in 1415, contrary to the promise of safety given him by the emperor Sigismund. The council of Constance, which examined him in his religious opinions, and condemned him so unjustly, basely held that the emperor was not bound to keep faith with a heretic. The Hussites, his followers, believed that the church consisted only of those predestinated to glory, and that the condemnation of the five-and-forty articles of Wycliffe was wicked and unreasonable. In his account of them, Moreri adds that they partly afterwards subdivided (after the death of John Huss), and opposed both their bishops and secular princes in Bohemia, where, if we believe the word of our author, they were the occasion of great disorders and civil commotions in the 15th century, after which date not much more is heard of them in history.

HUSTINGS, *hus'-tings* (Sax. *hustinge*, a council-house), the principal and supreme court of the city of London, held before the lord-mayor and aldermen, in the Guildhall. This court is of great antiquity, as honourable mention is made of it in the laws of King Edward the Confessor. In the Hustings court, at the present day, the aldermen and four members of parliament are elected. Other cities and towns have also had a court of the same name; as Winchester, York, Lincoln, &c. In common language, the term hustings is applied to the booth or elevated platform on which candidates at a parliamentary election are nominated, and from which they address their constituents before the show of hands is taken.

HUTCHINSONIAN PHILOSOPHY, *hutch-in-so'-ne-an*, a term applied to a system of philosophy first promulgated by John Hutchinson, in the early part of the 18th century. In 1724 he published a strange work, entitled "Moses' Principia," in which he endeavoured to disprove Sir Isaac Newton's doctrine of gravitation. Three years later he followed up his attack upon Newton, and quoted Scripture in proof of the existence of a *plenum*, in opposition to the doctrine of a *vacuum*. His views, although they have not been largely adopted, have found supporters in many able men, both in the Church of England and in dissenting bodies. The leading points of the Hutchinsonian philosophy are as follows:—that the Bible contains a complete and infallible system of natural history and philosophy, as well as of religion and theology. This, however, is not to be gathered from the ordinary translations, but from the Hebrew original. According to Hutchinson, Hebrew is the only complete and perfect form of speech, and was, on that account, chosen by the Almighty as his instrument of communicating with man. The Bible, however, is not to be interpreted according to the literal meaning of the words. The true is the typical sense, which can only be understood by a deep acquaintance with Hebrew etymology: and according to the theory, every root of that tongue contains hidden meanings, and symbolizes some recondite object. The Hutchinsonian theory rejects the received doctrines of gravitation, attraction, magnetism, and electricity, and denies the existence of a vacuum; while it maintains that the operations of nature are carried on by the three agents, fire, light, and spirit. These three agents are also considered to be merely a modification of one substance, the air; they are consequently held to be typical of the Trinity. This principle of symbolism is carried out through the whole of the Old Testament, and it is maintained that all the ceremonies of the ancient Jews shadowed forth the life and sufferings of Christ; and that the Jews, knowing this, observed these rites in the same manner and spirit as the followers of Christ afterwards obeyed and followed him. Two of the most distinguished upholders of the Hutchinsonian theory were Robert Spearman and Julius Bate, who superintended the third edition of Hutchinson's works.—Ref. *The Philosophical and Theological Works of the late truly learned John Hutchinson, Esq.*

HYACINTH, *hi'-a-sinth* (Lat. *hyacinthus*), a gen. of plants of the nat. ord. *Liliaceæ*. They are bulbous-rooted, with bell-shaped flower, 6-cleft perianth, and dry capsular fruit. The numerous and splendid varieties of the garden hyacinth (*H. orientalis*) have always been general favourites; and the fondness for these flowers in some countries almost amounts to a mania. It is a native of Persia, Asia Minor, and Syria, and is now naturalized in some parts of the south of Europe. It has broad linear leaves, with a raceme of many flowers. The colours of the cultivated hyacinth vary greatly, and are chiefly white, purple, and blue; many of them are double. The fragrance of the hyacinth is most powerful about eleven o'clock at night. In Holland more than 2,000 varieties have received distinct names, and the price of 1,000 florins has been given for a single plant. The environs of some of the Dutch towns present, through the profusion of these flowers, a gorgeous appearance. Hyacinth bulbs, planted in pots or grown in hyacinth-glasses, produce beautiful flowers.

HYÆNA, *hi-e'-na* (Lat.), belonging to the *Hyænina*, tribe of animals of the class *Mammalia*, order *Feræ*, and family *Felidæ*. According to naturalists, the hyænas are digitigrade animals, with more or less elongate limbs, and the body depressed posteriorly. The type of the family is the genus *Hyæna*, the species of which are characterized by the possession of four toes on each foot; thick, short, and blunt claws; and no small tubercular teeth in the lower jaw behind the molars. The dentition is regular; thirty-four teeth in number, eighteen in the upper and sixteen in the lower jaw. There are five molar teeth on each side in the upper jaw, and only four on each side in the lower. The dental formula is thus expressed:—

Incisors $\frac{v}{6}$, $\frac{1-1}{1-1}$, molars $\frac{5-5}{4-4}$; total: 34.

By the structure of their teeth, the hyænas are able to crush the bones of even the largest prey, and the muscles of their jaws and neck are so powerful, that it is almost impossible to take anything from them that they have seized. In habits they are less sanguinary than animals of a similar nature to themselves, and live more on dead prey, even preferring flesh that has become quite putrid. In general form they resemble the *Caninæ*, but are easily distinguished from them by reason of the obliquity of their bodies and their peculiar walk, which gives them the appearance of having their hind legs shorter than their fore ones; not that they are really so, as this results from their always being in a state of flexion. The muzzle is obtuse, like that of a dog, and the tongue rough and furry, like that of a cat. They are nocturnal animals, and are useful in eastern cities, where they act the part of scavengers, and carry off all refuse and decomposing bodies, during the night. Of the hyæna in ancient times many fabulous stories used to be related, which had not the slightest probable foundation. They were said to be hermaphrodites, changing their sex every year; also it was reported that if the shadow of their bodies fell on those

of dogs, it would render the latter dumb; and, finally, they were said to be able to imitate the voices of men, and to call them by name! The family of the hyænas are natives of Asia and Africa, and the common *Hyæna (vulgaris)*, or *striped hyæna* (*Hyæna striata*), is the best known of the different species. This animal is of a yellowish-grey colour, and the skin is crossed by deep transverse black bands. From the neck along the back a long black mane, mottled with yellow hair, extends to the tail, while the ears are of a brown colour, and nearly naked, broad at the base, long and erect. Of solitary retiring habits, it is, however, easily tamed by man, and will thus become a faithful watch-dog. It is called the *strand wolf* by the inhabitants of the Cape of Good Hope, where a variety of it is found. The spotted hyæna of the Cape (*Crocuta maculata*), or tiger-wolf, is smaller than the last-mentioned animal, and is of a brownish-yellow colour, diversified with [illegible] dark brown or black spots. The remains of [illegible] have been found in most tertiary formations over the greatest part of Europe, and one variety, that of the *Hyæna spelæa*, according to Cuvier's system, has been found in nearly every part of England.

HYBERNATION, *hi-ber-nai'-shun* (Lat. *hybernus*, wintry), a term applied to that state in which certain animals pass a portion of each year in a more or less complete suspension of their customary functions. As this is frequently observed during the severity of winter, it has been designated hybernation. In the tropics, however, the hottest and driest weather produces the same effect, and causes many reptiles, and some insectivorous animals, to pass into a state of torpidity or inactivity, till the rainy season commences. In fact, hybernation depends less upon the alternation of temperature than on the abstraction of the means of subsistence dependent upon it. The continued application of cold to some animals induces a suspension of their active faculties, and their hybernation may be dissolved by artificial heat: it is evident, however, that this state is not the consequence of a low temperature. Without hybernation, or some similar law, insectivorous animals, in high latitudes and tropical climates, could not exist. In complete hybernation, on the approach of the season, the animals retreat to their places of temporary concealment; there their vital functions begin to be more slowly performed; they cease to eat, breathe slower, until finally their respiration seems to be totally suspended. The movements of the heart become more and more languid, and are performed at longer intervals of time; the animal heat is much diminished; and, lastly, profound insensibility takes place. In this country the bat and the hedgehog present the best examples of hybernating animals. When the cold season sets in, and there are no insects in the air, and when other insects have burrowed into the earth or concealed themselves, the bat and the hedgehog would starve if it were not for their hybernation. The bat retreats to his cave, and suspends himself in a state of dormant existence; and the hedgehog creeps to his concealed nest, and sinks into deep repose. In some other European mammals the hybernation, though somewhat analogous, is not so complete. The dormouse, the squirrel, and the marmot, lay up stores of vegetable food in their winter retreats; but the insensibility in these animals is less profound, and the respiration never wholly suspended. During six months of torpidity, the Alpine marmot only makes 71,000 inspirations, while in its active state it makes 72,000 in forty-eight hours. The ordinary bear also passes a large portion of the winter in deep sleep without food. Many genera of the family *Mus* also exhibit the same peculiarity. All these animals become fat in the autumn, which appears to supply the waste of the system during hybernation. Snakes, lizards, toads, frogs, and other cold-blooded animals, remain in a complete state of torpor during the winter. The lips of frogs are glued together, and they lie buried in mud at the bottom of stagnant water. The snakes and lizards of North America are hybernating animals, as with us, but in warmer climates they are active throughout the year. Insectivorous birds are less subject to hybernation than mammals in cold climates, since they are able to migrate easily to regions where insect food can be [illegible]

HYBRID, *hi'-brid* (Gr. *hubris*, a mule), a mongrel produced, whether in plants or animals, by the impregnation of the female of one species, genus, or race, by the male belonging to a different family. The commonest sorts of hybrids are those which arise from the interconnection of different varieties of the same species; to notice which, the produce of the wild boar and domestic sow (*see* HOG) need only be mentioned. It is stated, in an article on the subject in Brande's Dictionary, that "specifical hybrids have been produced from the artificial fertilisation, by Kœlreuter, of the *Nicotiana rustica* with the pollen of *Nicotiana paniculata*; and Schiek has demonstrated, by numerous observations, that a multitude of plants produce specifical hybrids in a state of nature." Yarrell, in his "History of British Birds," states that the siskin and goldfinch are often bred with the canary, the pheasant with the common fowl, the swan with the goose, and many other birds, too numerous to mention. Among mammalia, however, although hybrids have been produced, they are not very common, although some have been obtained from the intermixture of the lion and tiger, the dog and wolf, and the horse and ass, the latter being extremely useful, and termed "the mule." Hybrids are generally sterile, and the intermixture of different species, according to Owen, is guarded against by the aversion of two specifically different individuals to sexual union.

HYDARTHRUS, *hi-dar'-thrus* (Gr. *hudor*, water; *arthron*, a joint), a white swelling. The joints most subject to this disease are the knee, ankle, elbow, and wrist. At first the swelling is slight, of the same colour as the skin, but very painful, diminishing the mobility of the part affected. It can be distinguished from rheumatic swelling of the joints by its fixed and wearing pain, which often exists for a long time before any enlargement of the part is perceptible.

HYDATID, *hi'-dăt-id* (Gr. *hudatis*, a vesicle, from *hudor*, water), a term applied rather vaguely to various cyst-like productions, which are sometimes found in the bodies of men and animals. Under the common denomination of hydatids, are included several very dissimilar objects. First, several species of entozoa, or parasitic animals, which have a distinct and separate vitality; secondly, simple unattached cysts; and thirdly, vesicular bodies, either wholly or partially connected with the tissues surrounding them. In 1686, Hartman first discovered that many of the bodies, or cyst-like tumours, were distinct parasitic animals. The discovery excited little attention till Linnæus and Pallas took up the investigation. Since that time the subject has been studied by many eminent naturalists. Hydatids are principally found in the bodies of mammals, and rarely in those of the lower animals. They occur in any part of the body, but are seldom met with in the mucous cavities and passages. The fluid which fills the proper cyst of a hydatid is nearly always colourless and limpid. The cysticercus, the cœnurus, and the echinococcus, are the principal forms of cystic entozoa recognized. The first of these is often generated in the disease of sheep called "the rot." Another species affects the hog, and produces the disease called leprosy, or measles. The *Polycephalus ovinus*, another hydatid of this kind, is found in the brain of sheep, oxen, and other ruminating animals. They occur frequently in one of the lateral ventricles of the brain of sheep, [illegible] they occasion a kind of giddiness, causing the a[illegible] turn round and round in one direction. This [illegible]is sometimes called "the staggers" in Engla[illegible] treatment in all cases, for the prevention or [illegible]l of hydatids, is very imperfect. They generall[illegible] in a disordered state of health; consequently, th[illegible] remedies are those which are likely to remove that state and improve the general health.

HYDNOCARPUS, *hid-no-kar'-pus* (Gr. *hudnon*, tubercle; *karpos*, fruit), in Bot., a gen. of the nat. ord. *Pangiaceæ*, consisting of arborescent unisexual plants, found in the hotter parts of India. The species *H. venenatus* has a poisonous fruit, which is used for stupefying fish. The seeds of *H. odoratus*, commonly termed *Chaulmoogra*, are employed by the Indian doctors as a remedy in some cutaneous affections.

HYDRA, *hi'-dră* (Gr. *hudra*, the water-snake), a constellation in the northern hemisphere, formed by Aratus. It is figured on the celestial globe as a snake of great

length, with a cup on its back, and a crow between the cup and the extremity of the tail. As it extends over such a great space in the field of the heavens, it has been divided into four parts, distinguished as *Hydra*, *Hydra* and *Crater* (the cup), *Hydra* and *Corvus* (the crow), and *Hydra continuatio*, or the continuation of Hydra. The largest star in the entire constellation is of the second magnitude, and is found in the part termed Hydra.

HYDRACIDS, *hi-dră'-sids* (Gr. *hudor*, water, and acid), in Chem., acids in which hydrogen is the acidifying principle. In the first days of modern chemical discovery, oxygen was thought to be the only acidifying principle,—hence its name; but the experiments of Davy on chlorine proved that certain bodies, such as chlorine and fluorine, entered into combination with hydrogen, forming with it acids similar in composition to those formed from oxygen. (*See* also SALTS.) The principal hydracids are the hydrochloric, hydrobromic, hydriodic, and hydrofluoric.

HYDRAGOGUE, *hi'-dră-gog* (Gr. *hudor*, water; *ago*, I expel), a term applied in Med. to violent cathartics, which bring away a large quantity of watery secretion from the intestines.

HYDRANGEACEÆ, *hi-drăn-je-ai'-se-e* (Gr. *hudor*, water, *aggeion*, vessel), in Bot., the *Hydrangea* fam., a nat. ord. of *Dicotyledones*, in the sub-class *Calyciflore*. It is often regarded as a sub-ord. of *Saxifrageæ*, with which it agrees in many important particulars; but it differs from that order in the plants composing it being of shrubby nature; in their having opposite leaves, which are always exstipulate; and in having frequently more than two carpels, with a corresponding increase in the number of styles and cells to the ovary. About one-half of the species are natives of China and Japan. The typical genus *Hydrangea* contains some familiar cultivated plants; as *H. arborescens*, *quercifolia*, and *hortensis*. The latter is the common garden hydrangea, which is much valued for its large fresh-looking leaves and dense bunches of rose-coloured, white, or blue flowers. This plant requires a constant supply of water in warm weather. The leaves of *H. Thunbergii* form the *Ama-tsjá*, or tea of heaven, of the Japanese. The root of *H. arborescens* is used medicinally in calculus complaints in some parts of North America, under the name of Seven bark.

HYDRARGYRUM, *hi-drar'-je-rum* (Lat.), quicksilver, or mercury. (*See* MERCURY.)

HYDRASTIS, *hi-drăs'-tis* (fr. Gr. *hudor*, water), in Bot., a gen. of the nat. ord. *Ranunculaceæ*. One species only is known, namely *H. canadensis*, the golden seal, orange root, or ground raspberry. This is a low perennial herb, indigenous to North America. Its rhizome, or root-stock, sends up, in early spring, a simple stem, from six inches to a foot high, which is two-leaved near the summit, and bears a single terminal greenish-white or rose-coloured flower. The fruit is of a red colour, and somewhat resembles an unripe raspberry. This little plant has of late attracted much attention, and almost every well-known pharmacologist has written upon its medicinal properties. Two active principles, *hydrastine* and *berberine*, have been extracted from the rhizome. Another preparation, called *hydrastin*, is much used by the medical men of America, who style themselves *Eclectics*; it is procured by the solvent action of alcohol. The preparations of *H. canadensis* are stated to have a specific influence over the mucous surfaces, and to be useful in gonorrhœa, gleet, dyspepsia, piles, constipation, ophthalmia, catarrh, and various other diseases. There can be no doubt as to the valuable tonic properties of this plant. The rhizome may be used as a dyeing agent.

HYDRATES, *hi'-draits* (from Gr. *hudor*, water), in Chem.—In combination with certain metallic oxides, water seems to play the part of an acid, forming a compound that may be considered as a pseudo salt. Thus, with oxide of sodium water forms the compound NaOHO, or hydrate of soda, which is quite a different body to the simple NaO; in fact, such is the attraction existing between the two bodies, that they cannot be separated by the strongest heat. The hydrated oxides of the heavy metals also differ in properties to the anhydrous oxides; sesquioxide of chromium, for instance, is not attacked by any of the acids, even with the aid of heat, but in the hydrated condition it is readily soluble in most of them. The combination of water with the oxides is always attended with the evolution of a large amount of heat; a familiar instance of which takes place in the slaking of lime. In the case of oxide of potassium and sodium, the action is so violent that the mass becomes incandescent.

HYDRAULIC CRANES.—Sir William Armstrong, who was the first to apply water-pressure to cranes, thus describes his most valuable invention:—"The employment of water-pressure as a mechanical agent having recently undergone a great and rapid development, I may be permitted to make a few observations on the successive steps by which its present importance has been attained. In so doing, I shall commence with the year 1846, in which, after many preliminary experiments, I succeeded in establishing on the public quay at Newcastle-upon-Tyne the hydraulic crane which has formed the basis of what has since been effected. This crane both lifted the weight and swung round in either direction by the pressure of water, and was characterized, like all other hydraulic cranes

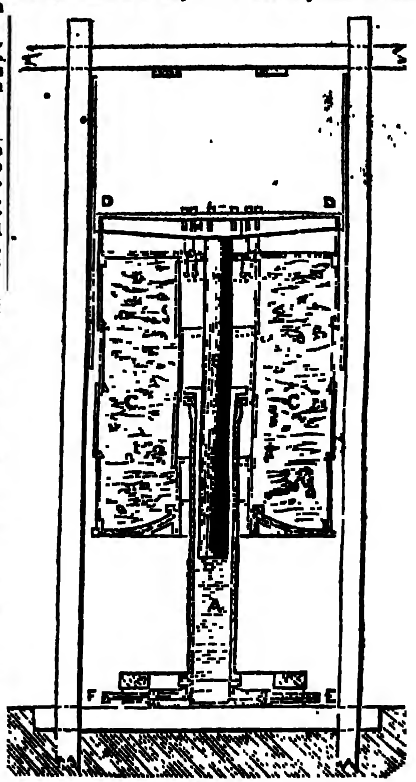


Fig. 1.

since made, by remarkable precision and softness of movement, combined with great rapidity of action. The experiment thus made at Newcastle having proved satisfactory, I soon afterwards obtained authority, through the intervention of Mr. Hartley, the dock surveyor of Liverpool, to construct several cranes and hoists upon the same principle at the Albert Dock, in that town, where they were accordingly erected, and have ever since continued in operation. The next place at which these cranes were adopted was Grimsby New Dock, where an important step in the advancement of this kind of machinery was made on the sug-

gestion of Mr. Rendel, who pointed out its applicability to the opening and closing of dock gates and sluices, and instructed me to extend its application to those objects. An extensive system of water-pressure machinery was accordingly carried out at that dock; and the result afforded the first practical demonstration that the pressure of a column of water could be advantageously applied as a substitute for manual labour, not merely for the stowage of goods, but also to give safe and rapid effect to those mechanical operations which are necessary for passing ships through the entrances of docks. In all these instances the moving column of water was about 200 feet in elevation. At Newcastle and Liverpool the supply was derived from the pipes communicating with the town reservoirs; but at Grimsby a tower was built for supporting a tank, into which water was pumped by a steam-engine. In the former case the fluctuation of pressure, conse-

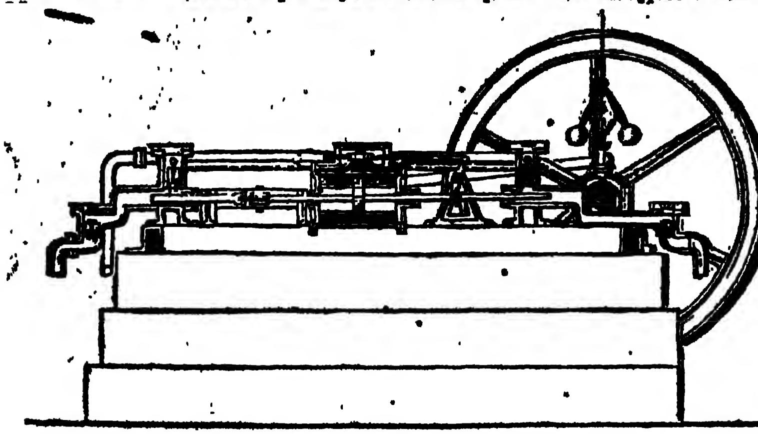


Fig. 2.

quent upon the variable draught from the pipes for the ordinary purposes of consumption, proved a serious disadvantage; but this objection had no existence at Grimsby, where the tank upon the tower furnished a separate source of power, undisturbed by any interfering conditions. Nothing could be more effectual for its purpose than this tower; but in the natural course of improvement, I was subsequently led to the adoption of another form of artificial head, which possessed the advantage of being applicable, at a comparatively small cost, in all situations, and of lessening the size of the pipes and hydraulic machinery by affording a pressure of greatly increased intensity. The apparatus thus substituted for a water-tower I named the 'Accumulator,' from the circumstance of its accumulating the power exerted by the engine in charging it. The accumulator is, in fact, a reservoir giving pressure by *load* instead of by *elevation*; and its use, like every provision of this kind, is to equalise the strain upon the engine in cases where the quantity of power to be supplied is subject to great and sudden fluctuations. The construction of the accumulator is exhibited in fig. 1, and needs but little explanation: A, cylinder; B, plunger; C C, loaded weight-case; D, D, guides for ditto; E, pipe from pumping-engine; F, pipe to hydraulic machine. It consists of a large cast-iron cylinder, fitted with a plunger, from which a loaded weight-case is suspended to give pressure to the water injected by the engine. The load upon the [illegible] is usually such as to produce a pressure in [illegible]der equal to a column of 1,380 feet in elevation; and the apparatus is made sufficiently capacious [illegible]tain the largest quantity of water which can be [illegible] from it at once by the simultaneous action of [illegible] the hydraulic machines with which it is connected. Whenever the engine pumps more water into the accumulator than passes direct to the hydraulic machines, the loaded plunger rises, and makes room in the cylinder for the surplus; but when, on the other hand, the supply from the engine is less for the moment than the quantity required, the plunger with its load descends, and makes up the deficiency out of store. The accumulator also serves as a regulator to the engine; for when the load-plunger rises to a certain height, it begins to close a throttle-valve in the steam-pipe, so as gradually to reduce the speed of the engine, until the descent of the plunger again calls for an increased production of power. The introduction of the accumulator, which took place in 1851, gave a great impulse to the extension of water-pressure machinery, which is now either already applied, or in course of being applied, to the purpose of cranage throughout all the great dock establishments in London, as also to a considerable extent in Liverpool and other places. I have also applied it extensively to railway purposes, chiefly under the direction of Mr. Brunel, who has found a multitude of cases, involving lifting or tractive power, in which it may be made available. Most of these applications are well exemplified at the new station of the Great Western Railway in London, where the loading and unloading of trucks, the hoisting into warehouses, the lifting of loaded trucks from one level to another, the moving of turntables, and the hauling of trucks and traversing-machines, are all performed by means of hydraulic pressure, supplied by one central steam-engine with connected accumulators. Mr. Rendel, after having successfully adopted the low-pressure system to the working of the gates and shuttles at Grimsby, has since applied the high-pressure, or accumulator system, to the same purpose at other new docks, and a similar adaptation is being made by other eminent engineers. I have also adapted hydraulic machinery to the opening and closing of swing-bridges and draw-bridges of large dimensions; and, in fact, there is scarcely any mechanical operation to which human labour has been hitherto applied as a mere moving [illegible]

retained as the source of power, the intervention of an accumulator will, in many cases, both economise labour and increase despatch. For example, a pair of heavy dock-gates requires the constant attendance of a considerable number of men, whose labour is only called into action occasionally,—viz., when the gates are being opened or closed. Now, if an accumulator charged by hand-pumps were used, the labour employed would be constant, instead of occasional, and the power collected in the accumulator by the continuous process of pumping would be given out in a concentrated form, and thus the ultimate result

would be effected by fewer hands and great [illegible] than when manual labour is directly applied. The form of pumping-engine which I generally use for charging the accumulator is represented in fig. 2. It consists of a horizontal steam-cylinder, with two force-pumps connected directly with the piston. These force-pumps are supplied with water from a cistern [illegible] engine-room, into which the water discharged by the cranes is generally brought back by a return-pipe, so that the water is not wasted, but remains continuously in use. With a pressure representing a column of 1,500 feet, the loss of head by friction in the pipes forms so small a deduction from the entire column, as to be a matter of no consideration, and, consequently, the distance at which the engine may

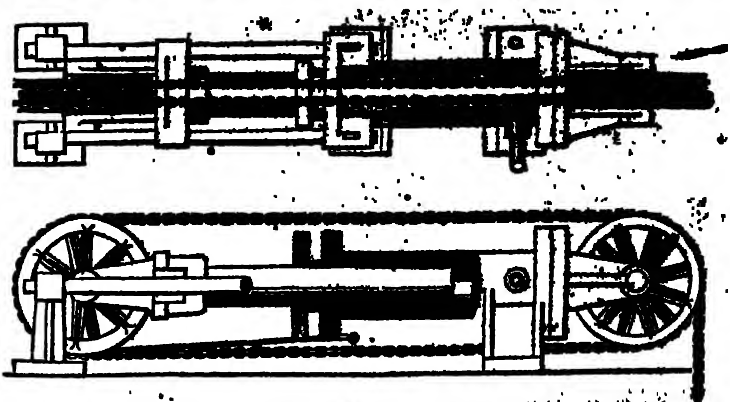


Fig. 2.

be situated from the points where the hydraulic [illegible] chines may be placed, is of little importance except as regards the cost of the pipe. It is adviseable, however, if the pipe be very long, to apply an accumulator at each extremity, so as to charge the pipe from both ends. With regard to the mechanism of hydraulic cranes, the arrangement which I first adopted, and have ever since adhered to, consists of one or more hydraulic presses with a set of sheaves used in the inverted order of blocks and pulleys, for the purpose of obtaining an extended motion in the chain from a comparatively short stroke of the piston. This construction, which characterizes nearly all the varieties of the hoisting- and hauling-machines to which I have applied hydraulic pressure, is exhibited in fig. 3, which represents one of these presses with sheaves attached, to multiply the motion fourfold. In cases where the resistance to be overcome varies very considerably, I generally employ three such cylinders, with rams or pistons acting either separately or conjointly upon the same set of multiplying-sheaves, according to the amount of power required. In hydraulic cranes the power is applied not only for lifting the load, but also for swinging the jib, which latter object is effected by means of a rack or chain operating upon the base of the moveable part of the crane, and connected either with a cylinder and piston, having alternate motion like that of a steam-engine, or with presses applied to produce the same effect by alternate action. The absence of any sensible elasticity in water renders it [illegible] capable of the most perfect control, by [illegible] valves which regulate the inlet [illegible] the machines; but this very [illegible] as much certainty of action, tends to cause shocks and strains to the machinery by resisting the momentum acquired by the moving parts. Thus, for example, the speed of an [illegible] with a load suspended on the jib, the motion being produced by water entering on one side of a piston and escaping from the other. Under such circumstances, if the [illegible]

passages be suddenly closed by the regulating-valve, it is obvious that the piston, impelled forward by the momentum of the loaded jib, but met by an unyielding body of water deprived of outlet, would be brought to rest so abruptly, as to cause, in all probability, the breakage of the machine. So, also, in lowering a heavy weight with considerable velocity, if the escape passage be too suddenly closed, a similar risk of injury would arise from the abrupt stoppage of the weight, if a remedy were not provided; but these liabilities are effectually removed by applying, in connection with the water-passages to the cylinder, a small check-valve opening upwards against the pressure into the supply-pipe, so as to permit the pent-up water in the cylinder to be pressed back into the pipe whenever it becomes exposed to a [illegible] the pressure on the accumulator. By this means all jerks and concussions are avoided, and a perfect control over the movement of the machine is combined with great softness of action. With regard to the kind of valve used for water-pressure machines, I find that either lift-valves or slide-valves may be effectually applied, and kept tight under heavy pressures, provided that sand be excluded from the water and the valves be made of proper material. In cases where a more prolonged movement is required than multiplying-sheaves will conveniently afford, I employ rotative machines of various constructions. For heavy pressures, such as an accumulator affords, an arrangement consisting of three plungers, connected with a triple crank, and bearing a general resemblance to a three-throw plunger-pump, is well adapted for the purpose. The admission- and exhaust-valves are mitred spindles, pressed down by weights and levers, and lifted in proper rotation by cams fixed for that purpose upon a separate shaft; and these valves are associated with relief-clacks, to obviate the concussion which would be liable to take place at the turn of each stroke. The liability of water machinery to be deranged by frost has often been adduced as an objection to its use; and upon this point I may observe —first, that I have never experienced any interference from this cause when the machines were placed, as [illegible] ally are, beneath the surface of the ground [illegible] a building; and, secondly, that when they [illegible] sed, all risk may be prevented by letting out the water in frosty weather whenever the machines cease working. When the moving power consists of a natural column of water, the pressure rarely exceeds 200 or 300 feet, and in such cases I have employed for rotative action a pair of cylinders and pistons, with slide-valves resembling in some degree those of a high-pressure engine, but having relief-valves to prevent shock at the return of the [illegible] Fig. 4 shows a slide-valve adapted for the apparatus of a crane, but the relief-clacks of

which are equally applicable to a water-pressure en-

so as to afford an escape for the water, which would otherwise be shut up in the cylinder when the exhaust-pipe closes, and the other two communicate with the discharge-pipe, so as to draw in a portion of waste

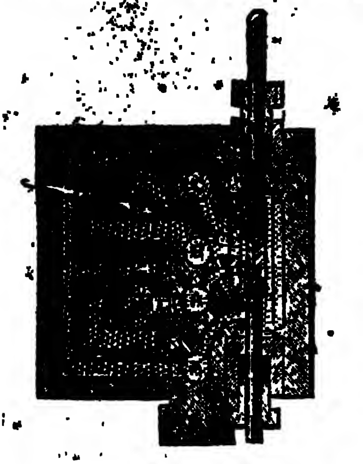


Fig. 4.

water to fill up the small vacancy which would otherwise be left in the cylinder on the closing of the admission port. A, supply-pipe; B, exhaust-pipe C, C, pipes to cylinder; D, D, clacks opening against pressure; E, E, clacks opening from exhaust. About four years ago I constructed four hydraulic engines upon this principle at Mr. Beaumont's lead-mines in Northumberland, at the instance of Mr. Sopwith, and two more have been recently added at the same place. They are used for crushing ore, for hoisting materials from the mines, for pumping water, and for driving a circular saw and other machinery."

Hydraulic Engineering, *hi-drawl'-ik* (Gr. *hudor*, water; *aulos*, a pipe), that branch of engineering which treats of the appliance of water as a motive power for mechanical purposes, and the methods that must be adopted to offer an effective resistance to the pressure which is exercised by any great volume of that fluid, whether it be in a state of rest or in motion. A knowledge of hydraulic engineering enables the civil engineer to take proper precautions in forming the foundations of the piers of bridges, and raising embankments, either to check the influx of the ocean or to prevent a river from overflowing its banks. An intimate acquaintance with this branch of engineering is also necessary in constructing canals, docks, piers, &c., building lighthouses, sinking wells, conveying water from a distance for supplying towns or irrigating land, and for planning and carrying out the drainage of any district by the formation of sewers and the various works in connection with them.

Hydraulic Lime, in Chem.—Ordinary mortar, when placed in water, softens, and the lime gradually dissolves; it is therefore useless for subaqueous purposes. Lime, however, which contains a small amount of silica and alumina, forms a mortar which hardens under water. Of this character is the porous material found at Puzzuoli, near Naples, which converts lime into hydraulic lime. Roman and Portland cement are made of lime burnt from an intimate mixture of chalk and clay at a [illegible] temperature. Mr. George Robinson, C.E., some time since read upon the subject of hydraulic limes before the of Arts, from which we will borrow an extract or two. In the work of extending the London Docks, the great mass of the concrete was made with naturally hydraulic lime—blue lias from Lyme Regis, in Dorsetshire, which requires no artificial mixture with puzzolana or minium to render it capable of setting permanently under water. The word "concrete," therefore, in this paper, implies that made with blue lias lime, unless otherwise specified. The Dorsetshire lime was the only lime burned on the works; all lias from Warwickshire or Leicestershire was bought ready burned from the merchants. The combination between the silica and lime, to which lias owes its hydraulic properties, ought only to take place in the humid way —*i.e.*, with the assistance of water, after the application of lime as mortar or concrete. There are two different kinds of lias as it comes from Lyme Regis, the one with a clean conchoidal fracture, the other of a shaly nature, approaching in appearance even to clay, but quite soft. The shaly lias, which contains so much clay as to have the properties of a cement, is not so desirable as the hard, clean stone, because it carries less sand, and is, therefore, more expensive. The stone cost 4s. 3d. a ton when shipped at Lyme Regis, but 10s. 9d. before it was stacked round the kiln in London. Notwithstanding the high price of the stone, the engineer-in-chief, Mr. Rendel, determined to burn the limestone in London, as the extra cost would be a comparatively small item in such extensive works. Two egg-shaped draw-kilns of brick were erected. Carbonic acid came away freely after the kiln had been lighted for three hours. An average of 11½ tons of stone burned by one ton of coal is very high; but the coal was Welsh, and cost a guinea per ton. Newcastle coal, or bituminous coal in general, was inadmissible; for it was essential to have little or no smoke in kilns in the heart of London. The cost of charging, including breaking up of the stone and coal, was 1s. 6d., if the two were mixed in the kiln. Each kiln had 100 tons of stone, and burnt 21 tons per diem. The two together produced 25 tons of quicklime every day, a quantity sufficient for about 97 cubic yards of mortar, or 170 cubic yards of concrete. The lime was ground to a fine powder between two pairs of horizontal French burr millstones, the upper one revolving at a rate of 90 revolutions per minute. Each pair of stones was capable of grinding three tons of quicklime per hour, at a total cost for grinding of one penny per bushel, when the consumption was 360 bushels per diem,—less if more was used. In buying ground lime from a dealer, if the purchaser buys by weight, he pays for the water absorbed from the atmosphere; if he buys by measure, he pays for the expansion caused by that moisture. The grindstones were composed of burrs from the fresh-water beds of the Paris basin, set in two radiated rings in cement, and backed up with plaster of Paris and mortar. The "skirts," or outside "burrs," were five inches thick; the central, or "high burrs," somewhat thicker, to allow for the "swallow," which is a slight depression in the centre of the upper stone, about two feet in diameter. This acts as a kind of distributing reservoir for the lime as it falls from "the hopper" between the stones.—*Ref.* Ure's *Dict. of Arts, Manufactures, and Mines*; General Pasley's works on Limes and Cements; and Mr. Timperley's papers in the Transactions of the Institution of Civil Engineers.

Hydraulic Press, a machine by means of which an intense pressure can be applied by the agency of water. [illegible] which it acts is founded on one of [illegible] laws of hydrostatics, that any non-elastic fluid, such as water, possesses the property of transmitting pressure exerted against it at any point [illegible] every direction. Hydraulic presses are used [illegible] such substances as hay, wool, and cotton, and all goods that will bear compression without injury, into bales and packages of convenient size for conveyance by vessel. The machine consists of two cylinders, one of which is considerably larger than the other in diameter, which are connected by a small pipe, that enters the larger cylinder at the bottom and the smaller one near the top. A ram works vertically through a water-tight collar in the upper end of the [illegible] cylinder, and exerts a pressure upwards; and a plunger, or solid piston, works upwards and downwards in the smaller one, like the sucker of a pump. The bottom of the lesser cylinder is connected with a tank, and water is drawn into it through a valve open-

Hydraulic Press

Hydraulic Press

ng upwards when the piston rises in the cylinder. When it descends again, the valve through which the water has been admitted closes, and the water is forced through another valve in the small pipe that connects the cylinders, into the larger one. At each successive stroke of the piston, water is driven into the larger cylinder, and the ram, being forced upwards by the pressure, transmits the force to the bed of the press placed above it, and compresses any substance that has been placed within the press. As every square inch of the area of the lower end of the ram receives exactly the same pressure upwards as may be directed downwards on every square inch of the sectional area of the plunger, it is manifest that the pressure exerted will be in proportion to the relative extent of the sectional areas of the piston and ram. Thus, if the sectional area of the ram be ten times as great as that of the piston, an upward pressure will be exerted by it equal to ten times the downward pressure exerted on the piston; but the larger the sectional area of the ram, that of the piston remaining unchanged, the more slowly it will rise in the cylinder, or, in other words, if the sectional area of the ram be ten times as great

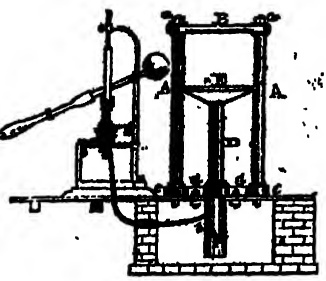


Fig. 1.

as that of the piston, it will rise $\frac{1}{10}$ of an inch for each inch through which the piston falls in its descent; and if it be twenty times as great, it will only rise $\frac{1}{20}$th of an inch for each inch through which the piston moves in a downward direction; for the volume of water displaced by the piston in each inch of its descent will be distributed over the whole superficial extent of the sectional area of the ram, and will manifestly become less in depth as the area over which it is distributed is increased in size. The invention of the hydraulic press is due to Blaise Pascal, but it was first made available for the purpose for which it is used by Bramah, who first introduced the machine in the year 1796. The principle upon which the press is constructed consists in the application of the common forcing-pump to the injection of water or some other incompressible and non-elastic fluid into a strong metallic cylinder, truly bored, and furnished with a movable piston, made perfectly water-tight by means of leather collars or packing neatly fitted into the cylinder. The proportion existing between the diameter of this piston and that of the plunger in the forcing-pump constitutes the principal element by which the power of the instrument is calculated; for, by reason of the equal distribution of pressure in the fluid, in proportion as the area of the transverse section of the one exceeds the area of a similar section of the other, so must the pressure sustained by the one exceed that sustained by the other. This is capable of generating and transmitting a degree of force, for the purpose of overcomi ne resistances and raising enormous loads to a height, than any other instrument or engine which we are acquainted; it is therefore of the most importance that the principles of its construction and the mode of operation should be rightly understood. Fig. 4 exhibits a side elevation of the press in its complete state, accompanied by the forcing-pump and all its appurtenances, as fitted up for immediate action:—F is a strong metallic cylinder of cast iron, or some other material of sufficient density to prevent the fluid from [illegible] its pores, and of sufficient strength to ossibility of rupture by reason of the immense pressure it is destined to withstand. The cylinder is bored and polished with the most scrupulous precision, and fitted with the movable piston D, which is rendered perfectly water-tight by means of leather collars constructed for the purpose, and fixed in the cylinder by a simple but ingenious contrivance, to be described hereafter. In the side or base of the cylinder F the end of a small tube (b b b) is inserted, and by this tube water is conveyed or forced into the cylinder: the other end of the tube is attached to the forcing-pump, as represented in fig. 1. A, A are two very strong upright bars, generally made of wrought iron, and of any form whatever, corresponding to the notches in the sides of the flat table E, which is fixed upon the end of the piston D, and by workmen usually denominated the "follower," or "pressing-table;" B is the top of the frame, into which the upright bars A, A are fixed; c c is the bottom thereof, both of which are made of cast, in preference to wrought iron, being both cheaper and more easily

Fig. 2.

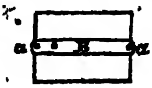


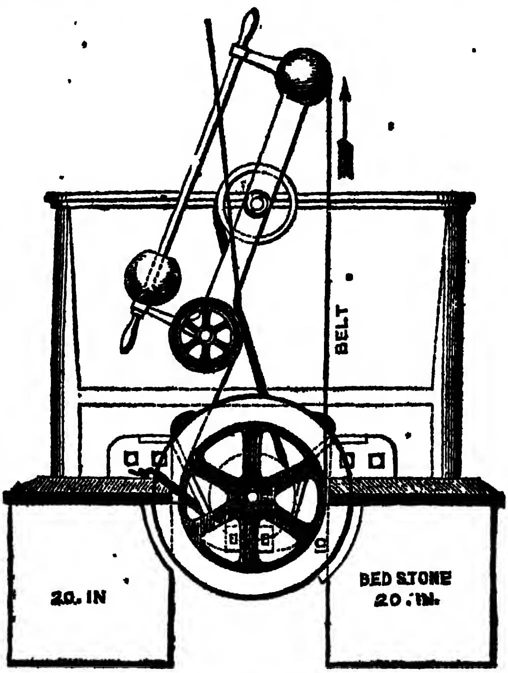
Fig. 3.

Fig. 4.

moulded into the intended form. The bottom of the frame c c is furnished with four projections, or lobes, with circular perforations, for the purpose of fastening it by iron bolts to the massive blocks of wood whose transverse sections are indicated by the lighter shades at G G. The top B has two similar perforations, through which are passed the upper extremities of the vertical bars A, A, and there made fast by screwing down the cap-nuts, represented at a and a. Fig. 2 represents the plan of the top, or, as it is more frequently termed, the head of the frame; the lower side, or surface, of which is made perfectly smooth, in order to correspond with, and apply to, the upper surface of the pressing-table E, fig. 1. This correspondence of surfaces becomes necessary on certain occasions, such as the of prints, taking facsimiles o in all such cases it is manifest that smooth and coincident surfaces are indispensable for the purpose of obtaining true impressions. Fig. 2 represents the upper side of the block, in which the middle part (B), through whose rounded extremities (a and a) the circular perforations are made for receiving the upright bars or rods A, A, fig. 1, is considerably thicker than the parts on each side of it. This augmentation of thickness is necessary to resist the immense strain that comes upon it in that part. Fig. 3 represents the plan of the base, or bottom, of the frame, which is generally made of uniform thickness, and of sufficient strength to withstand the pressure. The circular perforations c, c correspond to a, a in the top of the frame, and receive the upright bars in the same manner; the perforations d, d, d, d receive the screw-bolts, which fix the frame to the beams of timber represented at G, G, fig. 1; the large perforation F receives the cylinder, the upper extremity of which is furnished with a flange for the purpose of fitting the circular swell around the perforation, and preventing it from moving backwards during the operation of the instrument. A

side view of the engine, as thus completed, is represented in fig. 4, where the same letters refer to the same parts of the structure. F is the cylinder, into which the fluid is injected; D, the piston, on whose summit is the pressing-table E; A, one of the upright bars of malleable iron; B, the head of the press, fixed to the upright bar A by means of the cap-nut a; c, the bottom, in which the upright bar is similarly fixed; and G, a beam of timber, supporting the frame with all its appendages. In order to understand the operation of the press, we must conceive the piston D, fig. 1, as being in its lowest possible position in the cylinder, and the body or substance to be pressed placed upon the crown, or pressing-table E; then it is manifest that, if water be forced along the tube b b b by means of the forcing-pump, it will enter the chamber of the cylinder F immediately beneath the piston D, and cause it to rise a distance proportioned to the quantity of fluid that has been injected. The piston thus ascending carries its crown, and, consequently, the load as well, and by repeating the operation, more water is injected and the piston continues to ascend till the body comes into contact with the head of the frame B, when the pressure begins: thus it is manifest that, by continuing the process, the pressure may be carried to any extent at pleasure. When the press has performed its office, and it becomes necessary to relieve the action, the discharging-valve, placed in the furniture of the forcing-pump, must be opened, which will admit of the water escaping out of the cylinder, and return to the cistern; while the table and piston, by means of their own weight, return to the original position. Plates LXIII. and LXIV. show the elevation and plan of a press capable of giving a pressure equal to 30 tons weight, also of a press which is suitable for a pressure of 50 tons.

HYDRAULIC RAM, a hydro-dynamic machine of simple and beautiful construction, invented by Montgolfier at the close of the last century. Its object is to raise water without the aid of any other force than that produced by the *momentum* or moving force of a part of the water that is to be raised. The effect of its action is so great, that the machine appears to act in opposition to the laws of hydrostatic equilibrium; for a moving column of water is made to overcome and move another column much higher than itself. The ram itself consists, independently of the cistern, of a pipe, which carries the water to the working part of the machine, or *head* of the ram. This portion is composed of a short tube, at the end and upper part of which are two valves,—the ascension-valve and the stop-valve. The extremity ends in a receiver, filled in the upper part with air, and in the lower part with water, and communicating directly with the ascension-tube. The action of the ram is as follows:—The stop-valve being open and the ascension-valve shut, the water from the cistern passes out through the stop-valve. By this means the water passes from the cistern with increasing velocity, until at last the power of the current closes the stop-valve. The force which the water has acquired being thus momentarily checked, reacts upon the ascension-valve, which is opened, and a quantity of water is forced into the air-vessel. The compressed air in this receiver, reacting upon the surface of the contained water, closes the ascension-valve, and forces the water up the ascension-tube. In the mean time, the stop-valve naturally opens again, and the same process is repeated. Hence, the hydraulic ram, when once set in motion with a continual supply of water, will work by the momentum generated and destroyed for any length of time, if kept in repair.



HYDRO-EXTRACTOR.

HYDRAULICS, that portion of Natural Philosophy which treats of fluids in motion and the methods by which useful results are obtained from them. (*See* HYDRODYNAMICS; and for the application of hydraulic power, *see* HYDRAULIC PRESS, HYDRAULIC

RAM, ARCHIMEDEAN SCREW, PUMP, SIPHON, WATER-WHEEL, &c.)

HYDRIDES, *hī'-drīds*, in Chem., compounds formed of metals and hydrogen. Only three metallic hydrides are known at present,—the hydrides of arsenic, tellurium, and antimony. The organic hydrides are of great importance. (*See* HYDROCARBONS.)

HYDRIODIC ACID, *hīd-re-od'-ik*, in Chem., symbol HI, equivalent 128, spec. grav. 4·443, combining volume 4,—a colourless acid gas, formed by heating iodine in hydrogen. It fumes in the air, and is very soluble in water, and possesses a pungent irritating odour. It is generally prepared for use by placing in a small retort 10 parts of iodide of potassium, 5 of water, and 20 of iodine. One part of phosphorus cut into small pieces is then dropped in cautiously, and a gentle heat causes the gas to be eliminated abundantly. It may be collected by displacement in dry bottles; but water absorbs it with great avidity. This gas does not support combustion, and is not combustible itself. It may be liquefied, under strong pressure, into a yellow liquid, which freezes at −60° Fahr. Solution of hydriodic acid gas in water may be concentrated by evaporation until it acquires a density of 1·7, when it may be distilled unchanged at 262°.

HYDROBROMIC ACID, *hī'-dro-brō'-mik*, in Chem., symbol HBr, equivalent 81, spec. grav. 2·71, combining volume 4.—Hydrobromic acid is a compound of bromine and hydrogen, formed when bromide of potassium is decomposed by a concentrated solution of phosphoric acid. It is a colourless, uninflammable gas, and a non supporter of combustion. It produces a powerfully irritating effect on the lungs, and is readily absorbed by water to the extent of 47 per cent. of the gas. With the metallic oxides it forms the bromide of the metal and water. The concentrated solution may be distilled at 259° Fahr. without change.

HYDRO-EXTRACTOR.—An apparatus for removing liquids or moisture from yarns or cloths in the process of manufacture. The main feature or principle of the machine is extremely simple, consisting merely of a circular, open wire basket, in which the wet cloths are placed as uniformly as possible, and which is then made to revolve with such rapidity, that the moisture is thrown out by the centrifugal force through the interstices of the basket. As the *vis inertiæ* prevents the instant communication of a sufficient velocity to the basket loaded with heavy goods, various expedients have been resorted to to make communicated velocity progressive. The contrivances for this purpose were originally very complicated; but the arrangement shown in the annexed engraving, which is an exterior view of the machine and the driving apparatus, is much more simple, and perfectly effective. It is the invention of an American gentleman, Mr. C. Bryant, of Lowell, Massachusetts. The whole machine rests on two square bed-stones; the outside of the case, or tub, is only shown in the figure, within which the wire-basket, open at the top for the reception of the goods, revolves on a vertical shaft: to this shaft motion is communicated from the horizontal shaft beneath the tub by means of bevel-gears. On the extremity of this horizontal shaft is fixed the driving-pulley, as shown in the figure. This pulley is of the form usually employed on small tilt or trip-hammers; a belt passing round this pulley, and continually moving, communicates motion to the pulley whenever a binder brings the belt in close contact with its periphery. The binder is attached to the extremity of an oscillating frame, suspended from the top of the tub, as shown in the figure. The binder presses against the belt, so as to communicate motion to the pulley. To stop the motion, the upper end of the oscillating binder-frame is pressed down by a handle; the binder relieves the belt, and a rope attached to the periphery of a small pulley on the binder-frame, passing over a pulley fixed on the horizontal driving-shaft, and fastened at the other end to the bottom of the tub, acts as a friction-break to retard the motion of the tub, and, consequently, of the basket. To keep the binder-frame in extreme positions, a movable weight is placed on the handle-rod at the top of the frame, which slides from one end to the other of the rod, as the binder is raised or depressed. The basket in this machine is about 3½ feet in diameter, and in full action is capable of making 900 revolutions per minute. The driving-belt should be about 8 inches wide, the driving-pulley 18 inches in diameter.

HYDROCARBONS, *hī'-dro-kar'-buns*, in Chem.—The hydrocarbons, in organic chemistry, fall into three groups:—1. Those of the general formula C_nH_n, which are homologous with olefiant gas, C_4H_4; 2. those of the general formula C_nH_{n+1}, C_nH_{n+1}, which are called alcohol radicles; and 3. those of the general formula C_nH_{n+2}, which are homologous with marsh gas, C_2H_4. The following table of a few of these important bodies will give a general idea of their constitution:—

Olefiant gas series (C_nH_n).

Methylene	C_2H_2
Olefiant gas (ethylene)	C_4H_4
Tritylene (propylene)	C_6H_6
Hexylene (caproylene)	$C_{12}H_{12}$
Cetylene	$C_{32}H_{32}$

Alcohol radicles (C_nH_{n+1}, C_nH_{n+1}).

Methyl	C_2H_3, C_2H_3
Ethyl	C_4H_5, C_4H_5
Tetryl (butyl)	C_8H_9, C_8H_9
Hexyl	$C_{12}H_{13}$, $C_{12}H_{13}$
Octyl (capryl)	$C_{16}H_{17}$, $C_{16}H_{17}$

Hydrides of the alcohol radicles, or marsh gas series (C_nH_{n+2}).

Marsh gas (hydride of methyl)	C_2H_3, H
Hydride of ethyl	C_4H_5H
Hydride of tetryl	C_8H_9H

Besides these, there is an extensive series of double hydrocarbon radicles, formed by the combination of two alcohol radicles. Thus we have ethyl-tetryl, methyl-ethyl, and so on. Discoveries in relation to the hydrocarbons are being made so frequently, that in order to gain a correct knowledge of the subject, it is necessary to read the current chemical journals of the day.

HYDROCEPHALUS, *hī-dro-sef'-ā-lus* (Gr. *hudor*, water;

exclusively confined to infancy and childhood. Acute hydrocephalus is an inflammatory disease, rapid in its course, and requiring decided treatment; chronic hydrocephalus, on the other hand, may go on for many years. In acute hydrocephalus, the child is usually restless and fretful, the skin is hot and dry, the pulse quickened, the appetite is lost, and the bowels costive. The eyes are dull and heavy, the face flushed, and the child complains of pain and heaviness of the head. After a time, the symptoms become more manifest. The pain in the head becomes more intense, the restlessness is much increased, the expression of the countenance is altered, especially that of the eyes, which are often directed irregularly, with the pupils unequally dilated. The appetite is lost, and sometimes there is vomiting. The sleep is very much disturbed, and frequently the child awakes with a loud scream; the pulse is low and irregular, and frequently convulsions take place. The disease often proves fatal in two or three days, or even less; but sometimes it is protracted over two or three weeks, depending chiefly upon the age and strength of the child and the violence of the disease. The treatment of this disease must necessarily depend upon the strength and condition of the patient, the great object being to subdue the inflammatory action of the brain. Blood is to be freely abstracted by leeches, and some recommend the free use of the lancet. Active purgatives are also to be administered. When the active symptoms of the disease have been overcome, the system is to be gradually restored by tonics, cautiously administered. Chronic hydrocephalus differs from the other, not only in its progress being much slower, but from being rarely, or only slightly, attended with inflammation, and from there being always more or less of a collection of watery fluid in the brain, which is not invariably the case with the former. The chronic form is frequently hereditary, occurring in the children of weak or scrofulous parents, and it usually makes its appearance before, or speedily after birth. The fluid sometimes amounts to many pints, giving the head a very large and unsightly appearance. The fluid is

sometimes lodged in the membranes enveloping the brain, but more frequently it is contained in the ventricles, and other cavities of that organ itself. This disease is always attended with more or less of intellectual derangement. The vision is usually considerably impaired, with squinting; speech is imperfect, and the power over the voluntary muscles is partially lost. These symptoms gradually increase, convulsions and paralysis at length make their appearance, and death at last supervenes. The duration of the disease is extremely various; sometimes it may terminate fatally in a few months, at other times it may go on for many years. From the early period at which this disease usually makes its appearance, little can be done to arrest its progress. Sometimes puncturing the head has been attempted with success.

HYDROCHARIDACEÆ, *hi-dro-kă-re-dai'-se-e* (Lat. *hydrocharis*, the plant frog-bit), in Bot., the Frog-bit family; nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*. The plants of this order are inhabitants of fresh water in Europe, North America, the East Indies, and Tasmania. Their flowers are spathaceous, regular, diœcious, or polygamous; the perianth is superior, in 1 or 2 whorls of 3 pieces, the inner whorl being petaloid; the ovary is inferior, 1—9-celled; the fruit indehiscent, with numerous seeds, which are without albumen. The fresh-water aquarium has made many of these simple plants familiar objects. One of them, *Valisneria spiralis*, is the best and most lasting of all aquarium plants. *Anacharis alsinastrum*, the American water-weed, or water-thyme; *Stratiotes aloides*, the water-soldier; and *Hydrocharis Morsus-Ranæ*, the frog-bit, are also plants of this order, which have been transplanted from our ponds and ditches to the aquaria of our parlours and conservatories.

HYDROCHLORIC ACID, *hi-dro-klo'-rik* (from hydrogen and chlorine), in Chem., symbol HCl, equivalent 36 5, spec. grav. 1·2474, combining volume 4. *Synonyms:—Spirits of salt, marine acid, muriatic acid (chlorhydric acid*, Gerhardt). This most important compound of chlorine and hydrogen may be formed by direct synthesis of equal volumes of its components. Kept in the dark, they will remain separate for a length of a time; but the moment they are brought into the light, union takes place, gradually in diffused daylight, and with a powerful explosion if exposed to the direct rays of the sun. The affinity of chlorine for hydrogen is so strong, that if a solution of chlorine in water, or even the damp gas itself, is exposed to the light, hydrochloric acid is formed and oxygen is liberated. Hydrochloric acid gas is easily procured by pouring sulphuric acid over half its weight of common salt contained in a retort. The gas escapes abundantly, and may be collected either over mercury, or by displacement in dry bottles. The action is very simple, as will be seen from the following formula:—

$$NaCl + HO,SO_3 = HCl + NaO,SO_3,$$

or, in other words, the hydrogen replaces the sodium in the salt, the metal going to the sulphuric acid. It is a colourless gas, of a peculiar pungent odour, and an intensely acid taste, irritating the eyes and lungs considerably. It is heavier than air, having a spec. grav. of 1·247, 100 cubic inches weighing 39·61 grains. Under a pressure of 40 atmospheres, at 50° Fahr., it condenses to a colourless liquid. It is neither a combustible nor a supporter of combustion. It reddens litmus-paper powerfully, and forms white fumes in the air by condensing the moisture. Water absorbs 480 times its volume of this gas at 40°, increasing in volume by one-third, forming a colourless fuming liquid, known as hydrochloric acid in the laboratory. It is easily prepared by placing in a large retort three parts of fused chloride of sodium in fragments, and introducing five parts of sulphuric acid through a bent funnel. The retort is connected with a series of Woulfe's bottles, the first one containing a small quantity of water to absorb any impurities that may be present. The second bottle contains four parts of water, and should be immersed in cold water, as the condensation of the gas produces great heat. The acid is manufactured for commercial purposes in iron vessels connected with stoneware jars arranged as Woulfe's bottles. The amount per cent. of hydrochloric acid in solution is tested by a hydrometer. The metals liberate hydrogen from the solution, giving rise to water and the chloride of the metal. The following formula will illustrate this:—

NaO	+	HCl	=	NaCl	+	HO.
Soda.		Hydrochl. Acid.		Chloride of Sodium.		Water.

With organic bases, such as quinine, morphine, &c., hydrochloric acid appears to combine without the formation of water; but this is one of the many questions in chemistry still to be decided.

HYDROCOTYLE, *hi-dro-ko'-tile* (Gr. *hudor*, water; *kotule*, a cup or hollow vessel), in Bot., a gen. of *Umbelliferæ*. The species *H. asiatica* is now employed in India, both externally and internally, in leprosy and secondary syphilis, according to all accounts with considerable success.

HYDROCYANIC ACID, *hi-dro-si-ăn'-ik* (from hydrogen and cyanogen), in Chem., symbol HCy, equivalent 27, spec. grav. 0 9476, combining volume 4. *Synonyms: — Prussic acid (cyanhydric acid*, Gerhardt). This important compound is composed of equal volumes of hydrogen and the compound gas cyanogen, which, in this instance, comports itself like one of the halogens, chlorine or bromine. It is prepared in an analogous manner to hydrochloric acid, by submitting a cyanide to distillation with a strong acid. Cyanide of potassium is placed in a retort, and half its weight of dilute sulphuric acid is poured upon it. At first, the distillation proceeds spontaneously from the heat developed.

HYDRODYNAMICS, *hi-dro-di-năm'-iks* (Gr. *hudor*, water; *dunamis*, power), that branch of science which treats of the pressure, equilibrium, cohesion, and motion of fluids; and also of the machines by which water is raised, or in which water is used as the first mover. The subject is divided into two parts,—hydrostatics and hydraulics. The former includes the pressure, cohesion, and equilibrium of fluids, while the latter comprehends their motion, together with the machines with which they are connected. Many of the laws of hydrodynamics depend greatly upon the characteristic property of fluids; namely, that of *transmitting equally in all directions pressures applied at their surfaces*. As a science, hydrodynamics is, comparatively speaking, modern. It was cultivated with less success by the ancients than any other branch of mechanical philosophy. The general principles, however, upon which the science of hydrostatics is founded were first given by Archimedes, about 250 years before the birth of Christ. He maintained that each particle of a fluid in equilibrio is equally pressed in every direction; he also inquired into the conditions according to which a solid body floating in a fluid should assume and preserve a position of equilibrium. The first attempts at the construction of hydraulic machinery were made in the Greek school at Alexandria, which flourished under the patronage of the Ptolemies. The fountain of compression, the siphon, and the forcing-pump, were invented by Ctesibus and Hero, about 120 years after the birth of Christ. (The siphon, a simple instrument, used for emptying vessels, and the forcing-pump, a more complicated machine, will be found described in the articles PUMP, SIPHON.) The fountain of Hero, as it is usually called, is a machine, the principle of which depends upon the transmission of the pressure sustained by a body of water in one vessel to that in another, by means of the elasticity of air. An apparatus constructed on the principle of the fountain of Hero is employed for draining the water from the mines of Schemnitz, in Hungary. Notwithstanding these inventions of the Alexandrian school, its attention does not seem to have been directed to the motion of fluids. The first attempt to investigate this subject was made at Rome, in the reigns of Nerva and Trajan. From that time, very little advance was made in hydrodynamics till the end of the 16th century, when the discoveries of Castelli and Torricelli gave a new direction to the science of hydraulics. The discoveries of Sir Isaac Newton and other philosophers have caused this branch of science to progress rapidly in later years. The analytical theory of hydrodynamics resolves

itself into the integration of equations of partial differences. Euler, to whom this branch of the calculus is owing, gave the general formulæ for the motion of fluids, founded on the laws of their equilibrium, and thus reduced the whole mechanics of fluid bodies to a single question of analysis. Hydraulic machines are of great variety. They are of two kinds,—machines having a motion of rotation, and machines having an alternate motion. When water acts on a machine as moving power, it exerts, on the part impinged on, a pressure. The immediate effect of this pressure will be to make the part struck move in the direction of the power, or in some constrained direction; in either case the space will be passed through by the part. Among the machines having a motion of rotation may be mentioned water-wheels of varied kinds. They may be divided into two classes,—vertical wheels, with the axis horizontal, and horizontal wheels, with the axis vertical. The hydraulic machines which possess an alternate motion are the water-column machine and the hydraulic ram (which *see*). The water-column machine consists of a cylinder in which a piston is driven backwards and forwards by the weight of a high column of water contained in an upright pipe. A working beam is attached to the piston-rod, which transmits a motion to the common pumps. This machine, used in Hungary, is mentioned above as an adaptation of the principle of Hero's fountain. The machines for raising water are pumps, the Archimedean screw, and pail or bucket machines. Descriptions of the different hydraulic machines are given under the respective names of each.—*Ref.* Sir David Brewster's article on Hydrodynamics in the *Encyclopædia Britannica; Mosely's Elementary Treatise on Hydrostatics and Hydrodynamics; Bossut's Hydrodynamique.*

HYDRO-ELECTRIC MACHINE, a very powerful source of electricity, first observed by a workman in charge of a fixed steam-engine at Seghill colliery, near Newcastle-upon-Tyne. A large quantity of steam was escaping through a leak in the cement about the safety-valve; and the engineman, while endeavouring to adjust the weights on the safety-valve, noticed that a strong electric spark passed from the metal-work of the boiler, and from the boiler itself, it he tried to touch it while the steam was escaping. This phenomenon, he observed, was particularly apparent when one hand was immersed in the vapour. Sir William (then Mr.) Armstrong, having heard of the occurrence, investigated the subject experimentally. By means of an insulated brass rod, with a metallic plate at one end and a ball at the other, the former being immersed in the escaping steam, and the latter held near the boiler, he was able to obtain sixty or seventy sparks per minute. On the result of this experiment, Armstrong's hydro-electric machine was constructed. It consists of a steam-boiler, insulated by means of strong glass pillars, on which it rests. Attached to the upper part of the boiler a large number of bent iron tubes, terminating in wooden jets, allow the steam to pass out with considerable force. A conductor projects from the boiler, terminating in a knob, while in front of the bent tubes is a metallic case, containing several rows of points for carrying off the opposite electricity of the steam. It has been clearly shown by Professor Faraday that the electricity generated by this machine does not depend on the issue of steam through small orifices, nor on any chemical or physical change due to evaporation or condensation; but is merely the result of the friction of the water particles which are driven through the jets by the steam. These particles act similarly to the glass plate in the ordinary machine, and give out positive electricity; while the wooden jets and pipes act as rubbers, and give out negative electricity. The true source of electricity in the machine is in fact the friction of the steam; the boiler being negative and the escaping vapour positive. The best material for the orifice of the jet appears to be wood; while ivory is one of the worst. A small quantity of oil or turpentine in the exit-pipes produces a remarkable change in this machine; the electrical states become reversed, the boiler being positive and the steam negative.

HYDROFERRIDCYANIC ACID, *hi-dro-fer'-rid-si-an'-ik*, in Chem., symbol H_3Fdcy.—This compound is obtained in red crystals, by the evaporation of a solution of ferridcyanide of lead, which has been decomposed by sulphuretted hydrogen.

HYDROFERROCYANIC ACID, *hi-dro-fer'-ro-si-an'-ik*, in Chem., symbol H_2Fcy.—This acid is obtained, according to Liebig, by adding to a saturated solution of ferrocyanide of potassium, an equal volume of hydrochloric acid. The white precipitate of the acid thus obtained is mixed with hydrochloric acid, dried in vacuo on a tile, and crystallized by the addition of ether to its solution in alcohol.

HYDROFLUORIC ACID, *hi-dro-flu-or'-ik* (from hydrogen and fluorin), in Chem., symbol HF, a very remarkable acid, formed of fluorine and hydrogen. It has a very powerful affinity for silicon, abstracting it from its compounds with great facility. It is therefore necessary to prepare it in metallic vessels, its solvent action on glass being very great. In commerce, vessels of lead are generally used; but when it is desirable to obtain an acid of perfect purity, platinum vessels are employed. To prepare this substance, one part of finely-powdered fluor spar is mixed with two parts of oil of vitriol, and the gelatinous mass so formed is distilled in a leaden retort, to which a U tube is fitted. The U tube is surrounded by a powerful freezing mixture, and the acid distils over. Hydrofluoric acid is a densely fuming colourless volatile liquid, boiling at 60°, and freezing at about −4° Fahr. The preparation of the acid must be conducted with great care, as the fumes of it are very deleterious, and a drop falling on the skin will occasion a deep and painful sore. Poured into water, it causes the evolution of great heat. It is easily recognized by its corrosive action on glass, and a weak solution of it is much used in the arts for etching that substance. The glass to be etched is covered with bees-wax, the design being traced on the wax with an etching tool. The whole is then exposed to the action of the acid, which eats away those portions unprotected by the wax. Diluted hydrofluoric acid dissolves the metals, extricating hydrogen and forming fluorides.

HYDROGEN, *hi'-dro-jen* (Gr. *hudor*, water; *gennao*, I produce), in Chem., symbol H, equivalent 1; spec. grav. 0·0692, combining volume 2.—Hydrogen is an elementary substance, first isolated as a constituent of water by Cavendish in 1766. It is a colourless, transparent, tasteless, inodorous gas, permanent at all temperatures, and resisting all efforts to liquefy it. It is almost insoluble in water, 100 volumes of that liquid only absorbing two volumes of the gas. It is the lightest substance in nature, 100 cubic inches of it weighing only 2·14 grains. It was at one time doubtful whether it existed in the uncombined state in nature; but the experiments of Bunsen prove that it is evolved, although in very variable proportions, by the solfataras of Iceland. In combination as water, it is most extensively distributed throughout nature. It also exists in combination with hydrogen in most inflammable minerals. It is an important element in all organic substances, and enters into the composition of most substances in daily use, whether drawn from the mineral, vegetable, or animal kingdoms. Having a very great attraction for oxygen and chlorine, when in the nascent condition, it is much employed in the laboratory for deoxidizing or dechlorinating purposes. It is prepared in a variety of ways, the most usual being by pouring dilute sulphuric acid on granulated zinc or iron clippings, when the following reaction takes place:—

$$Zn + SO_3HO = ZnOSO_3 + H.$$

It may also be prepared by passing steam over red-hot iron filings, by plunging sodium or potassium into water, or by electrolysis of water; all of which methods are more scientifically interesting than practical. When zinc and dilute sulphuric acid are used, the gas passes off rapidly, and may be collected over water. Prepared in this way, it contains a number of impurities, such as arsenic, sulphur, antimony, &c.; but these may be removed by passing the gas through solutions of hydrate of potash, nitrate of silver, and oil of vitriol. Mixed with air, it may be breathed without any other effect than raising the pitch of the voice many notes higher. Mixed with oxygen, olefiant gas, or atmospheric air, it forms an explosive com-

pound of great power. The real nature of hydrogen has long been an interesting point of discussion amongst chemists, many supposing it to be a metal in a gaseous form, and prophesying with certainty, with Dumas, that if ever it is liquefied, it will present the appearance of quicksilver; while others contend, with Odling, that it is a neutral substance, possessing both the basic properties of a metal and the chlorous properties of a gas. Its power of being replaced by metals in its combinations has led Gerhardt and others to classify metals in accordance with their hydrogen-replacing power. Most metals replace one atom of hydrogen in its combinations, such as potassium, sodium, zinc, &c.; others replace two atoms of hydrogen, such as palladium, platinum, and tin; others again replace three atoms of hydrogen, such as bismuth, arsenic, and antimony. Others replace three atoms of hydrogen by two of metal; such as aluminium, iron, and manganese; while there are others, two atoms of which replace one of hydrogen. In these cases, the basicity of the metal is often expressed by dashes over its symbol. Thus, chloride of bismuth is written $Bi''Cl_3$, and bichloride of platinum $Pt''Cl_2$. This system of expressing basic power was first used by Odling. Hydrogen is not only replaced in its compounds by metals, but also by complex organic compound atoms; such as ethyl, methyl, &c. The theory, too, that hydrogen can only exist separately in the state of a double atom, is daily gaining ground, much light being thrown on the subject by the consideration of the properties of the hydrocarbons forming alcohol radicles. Thus, hydrochloric acid is represented as a double atom of hydrogen, in which one atom is replaced by chlorine. Its union with other bodies forms four great types, in which all compounds are modelled. These four are HCl, HO, H_3N, H_4C. (*See also* TYPES.) Hydrogen is used principally in the oxyhydrogen blowpipe. The chief compounds of hydrogen are water, ammonia, hydrochloric acid, and many others, which will be found described under their respective heads.

HYDROGEN, BINOXIDE OF, in Chem., symbol HO_2, equivalent 17.—This peculiar compound was discovered by Thenard, in 1817. It is generally prepared by digesting binoxide of barium with a dilute acid, at a low temperature. It is a colourless, transparent, syrupy liquid, with a harsh, bitter, and astringent taste. It does not freeze at $-22°$ Fahr., and evaporates without decomposition. Its specific gravity is 1·452. From the extra equivalent of oxygen being so loosely combined, it is set free on nearly every occasion. As might be expected, peroxide of hydrogen is a powerfully-oxidating agent. It has as yet received no extensive use, although it has been employed occasionally in medicine.

HYDROGEN, PERSULPHIDE OF, in Chem., symbol HS_2 (?), a light yellow, transparent, oily fluid, possessing a peculiar acrid odour and bitter-sweet taste, produced by adding an excess of hydrochloric acid to the solution of an alkaline pentasulphide. Owing to its property of dissolving sulphur, its composition has not yet been exactly made out.

HYDROGEN, TEROXIDE OF, in Chem., symbol HO_3, a product of the electrolysis of water, according to the experiments of Baumert.

HYDROGRAPHY, *hi-drog'-răf-e* (Gr. *hudor*, water; *grapho*, I write), a term applied to that part of science which relates to the description of the waters existing on the surface of the earth; particularly with reference to the bearings of the coast, the depth, currents, and other circumstances important or useful in navigation. Hydrography implies the same thing with regard to the sea that geography implies with respect to the land.

HYDROMETER, *hi-drom'-e-ter* (Gr. *hudor*, water; *metron*, a measure), an instrument for determining the relative densities, or specific gravities, of fluids; and thence the strengths of spirituous liquors, which are inversely as their specific gravities. The principle upon which the ordinary hydrometer is constructed is as follows:—When a body is immersed in a fluid, it loses as much of its weight as is equal to the weight of the fluid which it displaces. Thus, if a body be suspended from one arm of a balance, and counterpoised by applying weights to the other arm; and then, while suspended, it be immersed in water, it will be found that the counterpoising weight is not sufficient, and in order to restore equilibrium, a weight equal to the weight of the water displaced must be added. If, then, the same body be immersed in two different fluids, the weights which it will respectively lose in each will be directly proportional to the specific gravities of the fluids, because the loss of weight is always equal to the weight of the fluid displaced,—that is, the magnitude of the body multiplied by the specific gravity of the fluid. The same principle holds good in the case of substances which are lighter than the fluid; for when a body floats upon the surface of a fluid, the weight of the portion of fluid displaced is equal to the weight of the floating body. Upon this principle in hydrostatics, Sykes's hydrometer is constructed. This instrument is directed by act of parliament to be used in collecting the spirit revenue of the United Kingdom. It consists of a thin, flat stem, about six inches in length, divided on both sides into eleven equal parts, each of which is again subdivided into two. This stem carries a hollow brass ball, about one inch and a half in diameter, in which is fixed a conical stalk terminating in a pear-shaped weight, so that when the instrument is placed in a fluid, it may float with the other extremity perpendicular to the surface. Ten different weights of different magnitudes are also applicable to the lower portion of the graduated stem. Nine of these weights are circular, with a slit in each to fit the stem, and are numbered respectively 10, 20, 30, 40, 50, 60, 70, 80, and 90. By the successive application of these, the instrument may be sunk so as to obtain the whole range of specific gravities, from pure alcohol to distilled water. The tenth weight is in the form of a parallelopiped, and can be fixed, when necessary, to the upper part of the stem. In order to calculate the strength of a portion of spirit by this hydrometer, a portion of the liquid is placed in a tall glass vessel, and the temperature noted by means of the thermometer. The instrument is then floated, and one or more of the weights is added, until the lower part of the scale sinks beneath the surface. The number on the stem in contact with the surface is then observed, and added to the number of the circular weight employed; and this third number is referred to a series of tables calculated for the purpose. In these tables, under the proper temperature, will be found the percent age of strength required. The method adopted by chemists for finding the specific gravities of liquids is not by means of delicate glass hydrometers only, but also by means of the specific-gravity bottle, or thousand-grain bottle. (For other methods for obtaining like results, *see* SPECIFIC GRAVITY.)

HYDRONITROPRUSSIC ACID, *hi'-dro-ni'-tro-prus'-sik*, $H_2Fe_2Cy_5NO_2$.—When binoxide of nitrogen is transmitted through a solution of hydroferridcyanic acid, it is absorbed, hydrocyanic acid being disengaged, and a new acid—hydronitroprussic acid—is formed, which, when combined with the metals, gives rise to the nitroprussides (which *see*).

HYDROPATHY, *hi-drop'-ă-the* (Gr. *hudor*, water, and *pathos*, disease), is a mode of curing disease by means of the application of water. The system owes its origin to one Vincenz Priessnitz, who, in 1826, established an institution at his native place, Gräfenburg, in Austrian Silesia, for the cure of diseases on this mode. The system soon spread, and now there are in this country a number of hydropathic establishments. Without claiming for the system all that its votaries demand, there can be no doubt that it is of the greatest benefit in a large number of cases. Particularly is it of benefit in cases of indigestion, nervousness, an impaired constitution, a too full habit, or in such as have been living freely, without taking much exercise. The system of dietary and exercise that is kept up at these places is perhaps not less conducive to a cure than the baths. Having, under the head BATH, already noticed at length the different forms of baths, and the great importance of bathing, little more remains for us here than to notice shortly some of the forms in which it is employed as a remedial agent. These are very various. Besides the ordinary bath and the shower bath, one of the most common is the douche bath, in which a single jet of water, varying in size from the thickness of a quill pen to that of a man's

arm, is projected with great force, either from above, below, or one side, upon a particular part of the body. The sitz bath is taken sitting; besides which there are the foot-bath, hand-bath, &c. Sometimes, when the patient is sitting in a warm or tepid bath, cold water is poured over the head and upper part of the person. Pieces of coarse linen, saturated with cold water, are also applied to the skin, and covered over with dry cloths, and usually re-moistened several times a day. The wet sheet packing is one of the characteristics of the system. It consists in the patient being closely enveloped in a sheet, wrung out of cold water, and then covered over with dry blankets. The great importance of hydropathy consists in the healthy stimulus which it gives to the nerves, bracing them, and acting as a tonic, and soother to the whole system.

HYDROPHOBIA, *hi-dro-fo'-be-ă* (Gr. *hudor*, water, and *phobeo*, I fear), is a disease occasioned by the bite of a rabid animal, and so called from the great dread that those who suffer from it manifest at the sight of water. The dog, cat, fox, and wolf, are the animals among whom this disease is most common,—among whom it is natural; but there is perhaps no animal to whom it is not capable of being communicated, as it is to man. A dog who is suffering from this disease, becomes solitary, morose, and sullen; runs about wildly, and bites at whatever comes in his way; but his respect for his master is at first unaltered. As the disease advances, he becomes more furious, gnawing and biting at whatever comes in his way; he forgets his master, he breathes quickly and heavily, his tongue hangs out, his mouth is continually open, and discharges a large quantity of froth. In this state he seldom lives more than four-and-twenty hours. The poison exists in the saliva of the rabid animal, and may be communicated either by a bite, or by licking a wounded part. After the poison has been received, the wound usually heals up in the ordinary way. At a period, however, varying from a month or six weeks to perhaps eighteen months, symptoms of the disease begin to [illegible]. The part becomes painful, red, and swollen, and shooting pains are felt, extending from it to the central parts of the body. Very soon after this (within a few hours perhaps, but certainly within a few days), the specific constitutional symptoms make their appearance, he is hurried and irritable; speaks of pain and stiffness perhaps about his neck and throat, unexpectedly he finds himself unable to swallow fluids, and every attempt to do so brings on a paroxysm of choking and sobbing, of a very distressing kind to behold. The symptoms rapidly increase in severity. The nervous irritability becomes extreme, the paroxysms are greatly more violent, and are excited not only by any attempts to swallow liquids, but by the very sight or sound of them; even the waving of a polished surface, as of a mirror before the eyes, or the passage of a gust of wind across the face, being sufficient to excite it. Death occasionally takes place within twenty-four hours, but sometimes it may be protracted to the fifth or sixth day; usually, however, it terminates fatally on the second or third day. Nothing can be said to be known of the nature or character of this disease, and as little is known regarding its treatment. Various means have been tried, but few, or any of them, have met with any success, and none of them have received general adoption. It is not, however, every one that is bitten by a rabid animal that has hydrophobia. John Hunter records that in one case twenty-one persons were bitten by a mad dog, and only one of them had hydrophobia; and others have come to the conclusion, that on an average, only one person in twenty-five bitten will have hydrophobia. In the treatment of this disease, the great thing is to remove the poison before it has extended itself into the system. This is best done, where possible, by excision of the wounded part, care being taken that every portion of it is removed. Where it is impossible to use the knife effectually, a powerful caustic should be applied freely over the whole surface of the wound, so as to destroy the effect of the poison. As the poison is not very active, these means are usually effective, though employed some time after the receipt of the wound; but, of course, in such circumstances, all due haste is to be adopted, and it is well, before the arrival of medical assistance, to keep carefully washing the part with tepid water.

HYDROPHYLLACEÆ, *hi-dro-fil-lai'-se-e*, in Bot., the *Hydrophyllum* fam., a nat. ord. of *Dicotyledones*, sub-class *Corolliflora*, consisting of herbs, bushes, and small trees, having the following characters:—Leaves usually hairy, lobed, and alternate; flowers either solitary, stalked, and axillary, or arranged in circinate racemes or spikes; calyx persistent, 5-partite; corolla regular, 5-cleft; stamens equal in number to and alternate with the segments of the corolla; ovary simple, 1—2-celled, with 2 parietal placentas; styles and stigmas 2, and 2 or many ovules; fruit capsular, 2-valved, 2- or 1-celled, with a large placenta filling the cell; seeds netted; albumen hard and abundant. The plants of this order are chiefly natives of the northern and most southern parts of the American continent. Many of them are cultivated in our gardens, and are highly valued for their pretty flowers. The most common are the species of *Nemophila* and *Hydrolea*.

HYDROSTATICS, *hi-dro-stăt'-iks* (Gr. *hudor*, water; *statikos*, static, standing, or settling). (*See* HYDRODYNAMICS.)

HYDROSTATIC BELLOWS, an apparatus for illustrating that singular property of liquids in virtue of which they transmit pressure in every direction equally. In general form it consists of two flat boards, united by water-tight leather or flexible cloth. Communicating with the interior of this bellows is a short tube fitted with a stop-cock, by which the liquid may be discharged. From this short tube a long tube rises perpendicularly, terminating in a funnel. Weights are then placed on the upper board of the bellows, and water poured into the funnel. The water passes into the bellows, and lifts the weights. The load which can be thus lifted may be determined thus:—Every portion of the board will be pressed upwards by a force equal to the weight of the water in the tube above the level of the board. Thus, if the section of the upright tube be 1 square inch, and the surface of the board 500 square inches, then a column of water in the tube weighing 1 lb. will lift a weight of 500 lb.

HYDROSTATIC PRESS. (*See* under the head of HYDRAULIC PRESS.)

HYDROSULPHOCYANIC ACID, *hi'-dro-sul'-fo-si-ăn'-ik*, in Chem., H,CyS_2.—When dry sulphuric oxide of mercury is decomposed by a current of sulphuretted hydrogen, a colourless liquid is formed, which crystallizes in radiated masses at 10° Fahr. It has a pungent odour, somewhat resembling acetic acid, and is highly poisonous. It boils at 216°, and may be distilled at that temperature without undergoing decomposition.

HYDROSULPHURIC ACID, *hi'-dro-sul-fu'-rik*, in Chem., sulphuretted hydrogen,—symbol HS, equivalent 17, combining volume 2, spec. grav. 1·1912. This important compound of sulphur and hydrogen is generally known by its second name; but as it possesses acid properties, it may be called hydrosulphuric acid or sulphydric acid. It is generally prepared for use by submitting one of the metallic sulphides to the action of an acid, when it is disengaged in great abundance. For general purposes, the sulphide of iron is broken into small fragments, and placed in a bottle, a mixture of sulphuric acid and six or seven times its weight of water is added to it, and the gas gradually passes over. It is a transparent colourless gas, having the characteristic odour of rotten eggs. It is highly poisonous in a concentrated form, and is fatal to the lower animals, even when very much diluted. It is inflammable, burning with a pale bluish flame, depositing sulphur as it consumes. It dissolves in half or one-third of its bulk of water, forming a solution possessing weak acid properties. Exposed to the air, the solution becomes milky, and deposits sulphur. Under a pressure of seventeen atmospheres, sulphuretted hydrogen is reduced to a colourless invisible liquid, which freezes at —122° Fahr., into a transparent mass. It is a constituent of many springs; the baths of Aix-la-Chapelle and Harrogate owing their efficacy to this gas. It is of great use in analysis, in forming characteristic precipitates of the metals. When passed through solutions of the metals, it throws down the sulphide in the same manner that hydrochloric acid gives rise to the chlorides of the metals with which it is united. It exhibits a great tendency to unite with the soluble sulphides, compounds formed on the type of

KS,HS. The so-called hydrosulphate of ammonia of the laboratory is a hydrosulphate of the sulphide of ammonium

HYGROMETER, *hi-grom'-e-ter* (Gr. *hugros*, moist, *metron*, a measure), an instrument for ascertaining the amount of aqueous vapour present in the atmosphere or other aëriform fluid under examination. Several varieties of apparatus have been invented for this purpose. Any alterations in the state of the atmosphere, with respect to moisture or dryness, are manifested by different phenomena. The various forms of hygrometers are thus very great; but they can generally be divided into two distinct classes,—those which depend on absorption, and those which depend on condensation. A great number of substances in nature absorb moisture in a greater or less degree, and consequently undergo some change, either in regard to their physical qualities, their size, or their weight. Animal fibre is elongated, on account of being softened and relaxed; while vegetable fibre is shortened, on account of its swelling. Moisture is imbibed with avidity by many mineral substances, which gain weight by that means. Many of the hygrometers which depend upon this alteration of dimension or weight are known by the names of their inventors; as De Luc's, De Saussure's, Daniell's, &c. De Luc employed a thin slip of whalebone, the contractions of which indicated the variations of moisture. De Saussure employed a human hair, by means of which he constructed a far more delicate instrument; but unfortunately it was exceedingly liable to derangement, and, moreover, was uncertain, unless prepared with extreme care. The hygrometer invented by Mr. Daniell, the late professor of chemistry at King's College, London, has nearly superseded every other kind. It consists of two thin glass balls, of 1¼ inch diameter, connected together by a tube having a bore about ⅛ inch. The tube is bent at right angles in two places, so as to form three arms of unequal length, the longest of which contains a small thermometer, having its bulb in the lower of the two glass balls. This ball after being filled about two-thirds with ether, is held over a spirit-lamp till the air is entirely expelled through a capillary tube left open for the purpose. After the air is all expelled, the tube is hermetically closed. The other ball is then covered with a piece of muslin, and the instrument is placed on a stand to which another small thermometer is attached. In using the hygrometer, a small portion of ether is first poured upon the muslin, which, as it evaporates, lowers the temperature of the ball, and thus causes a rapid condensation of the ethereal vapour within. As it continues to condense, the ether in the lower ball continues to evaporate, by which the temperature of the included ether is reduced until a deposit of moisture is observed to take place on the exterior of the instrument. By observing the temperature indicated by the inclosed thermometer, the dew-point is ascertained,—that is, the point at which the precipitation of atmospheric moisture takes place. This instrument is very beautiful in principle, but it is doubtful as to whether it ever shows precisely the temperature at which the deposition of dew does take place. It is also costly, on account of its great consumption of ether. From 1840 to 1847 it was exclusively used at the Royal Observatory at Greenwich, since which time the observations have been taken from the simultaneous reading of two thermometers, the bulb of the one being wet and the other dry. In the use of Daniell's hygrometer, after the dew-point has been observed, together with the temperature of the external air, the actual quantity of moisture contained is found from the following formula,—where t denotes the temperature of the surrounding air, and p the elasticity of aqueous vapour at the temperature indicated by the inclosed thermometer:—

$$\text{Weight in grains} = \frac{5856\cdot2}{448+t} \times p.$$

HYLÆOSAURUS, *hi-le-o-saw'-rus* (Gr. *hyle*, weald or forest; *sauros*, lizard), in Geol., one of the gigantic terrestrial lizards whose remains were discovered by Dr. Mantell in the Wealden strata of Tilgate Forest. The restoration of this old-world monster by Mr. Waterhouse Hawkins occupies a prominent position among the palæontological illustrations in the grounds of the Crystal Palace. Dr. Mantell inferred, from the size and form of the bones of the head and jaws, that the creature must have attained a length of from twenty to thirty feet. The body was broader than high, and terminated by a long flexible tail; the limbs were relatively short; the skin was covered with scales and tubercles; and a row of very large thin angular spines extended down the back, and formed a serrated dermal crest.

HYMENÆA, *hi-men-e'-ă* (from Gr. *humen*, a membrane), in Bot., a gen. of the nat. ord. *Leguminosæ*, and sub-ord. *Cæsalpinieæ*. The species *H. Curbaril*, the West-Indian locust-tree, is supposed to yield gum-anime or East-Indian copal. The inner bark is stated to possess anthelmintic properties. The fruit contains a mealy substance, in which the seeds are imbedded, sweet and grateful to the palate: this, when boiled and allowed to ferment, forms an intoxicating drink resembling beer. The timber is close-grained and tough, and is well adapted for planking vessels. The species *H. verucosa* probably furnishes some of the East-Indian copal; and some other species is probably the source of Mexican copal. Brazilian copal is said to be the produce of several species of *Hymenæa*, and also of a plant belonging to the same sub-order; namely, *Trachylobium martianum*. Again, several species of the genus, together with *Guibourtia copallifera*, furnish the three kinds of copal known respectively as African copal, African yellow gum, and African red gum.

HYMENOPTERA, *hi'-men-op'-te-ră* (Gr. *humen*, a membrane; *pteron*, a wing), one of the orders into which insects are divided. They are characterized by possessing four membranous wings, of which the anterior pair are the larger, and they cross horizontally over the body when in a state of repose. Of all the orders into which insects are separated, the hymenoptera contains the largest number remarkable for development of instinctive powers and social qualities. The females are provided with an ovipositor, consisting chiefly of three elongated slender processes, of which two serve as a sheath to the third. This ovipositor, in many species, is so organized that, with it, they are not only able to perforate the substances in which they deposit their eggs, but, in many cases, it serves as a weapon of defence, and is the part which, in bees and wasps, is called the sting. With this weapon, which is barbed at the apex, they are able to kill their enemies, or render them torpid or powerless. The antennæ are generally filiform or setaceous. The mesothorax and the metathorax are well developed; the protothorax is narrow. Hymenopterous insects are remarkable for the great development of the aërial tracheæ, which, in many species, are placed in their abdomen, in pouches, and are very large in comparison with the size of the insects. They undergo what is termed incomplete metamorphosis; and in the greater number the larvæ are soft, whitish-coloured, and destitute of feet. In the imago, or perfect state, most hymenopterous insects live upon flowers, or, at least, often frequent them; some for the purpose of gathering honey, and others in order to find a safe retreat from whence they can attack their prey. The order *Hymenoptera* is divided by Latreille into two great sections,—the *Terebrantia* and the *Aculeata*. In the former, the female possesses a distinct ovipositor, and in the latter that organ is replaced by a sting. Many of the ants, however, prove an exception, since they do not possess a sting, but merely defend themselves by ejecting an acid liquid. The best-known families of the *Hymenoptera* are the bees, the wasps, and the ants. A description of these particular insects will be found under their respective names.

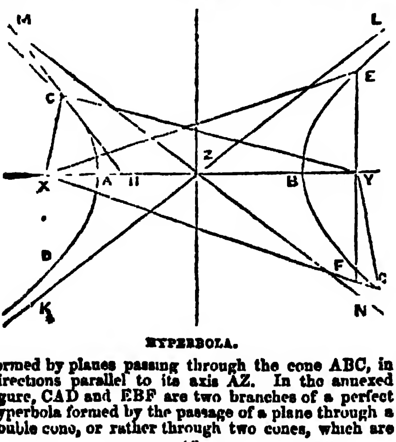
HYMN, *him* (Lat. *hymnus*, Gr. *humnos*), a song of praise or adoration in honour of a deity, generally accompanied by some instrument. It is supposed to have been originated by Orpheus and Linus, and Pindar is also said to have made his first essays in literature in the shape of hymns. Amongst the Greeks, the hymn consisted of three couplets,—the *strophe*, the *antistrophe*, and the *epode*. St. Hilary, bishop of Poictiers, is said to have been the first who composed hymns for churches. The Te Deum and Benedictus in our liturgy are both called hymns, while the composition of the former is attributed to St. Ambrose, who

succeeded St. Hilary in hymn-writing. Those in the Roman breviary were in all probability written by Prudentius. The term is now applied to any short religious poem, not being a version of a psalm, sung in places of public worship. They may be said to consist of three kinds,—1. *Metrical*, or such as were in use in the daily service of the unreformed Church, and of which the only one now formally authorized by the Church of England is the Veni Creator; 2. *Canticles*, appointed to be sung or said in the daily service, and divided into verses, and pointed like psalms; and 3. those portions of the Communion service which are to be said or sung, but not arranged like canticles; as the Tersanctus and the Gloria in Excelsis.—*Ref.* Hook's *Church Dictionary*; Moore's *Encyclopædia of Music*.

HYOSCYAMUS, *hi-os-i'-ă-mus* (Gr. *huoskuamos*), Henbane, a gen. of the nat. ord. *Atropaceæ*. The common henbane, *H. niger*, is an indigenous plant, growing on waste grounds, banks, and commons. It is glandular and viscid, and exhales a peculiar odour, which is fœtid and powerful. It blossoms in June or July, the flowers being of a pale straw-colour, beautifully pencilled with purple veins. The fruit is the peculiar modification of the capsule termed a *pyxis*, from its opening transversely by a lid, like a pill-box. The whole herb possesses narcotic properties, and has been employed medicinally from the earliest times as a narcotic anodyne, and soporific. It is sometimes used by oculists in place of belladonna to dilate the pupil. When swallowed in sufficient quantity, it is stated to cause loss of speech, disturbance of vision, distortion of the face, coma, delirium, phantasms, and paralysis. No antidote is known. Its activity is essentially due to the presence of the alkaloid *hyoscyamia*. Two varieties of henbane are commonly cultivated,—the *annual* and the *biennial*, the latter being generally regarded as the most active in its properties. The leaves only are used in regular practice: they are given internally in the form of powder, or in extract or tincture, and applied externally in fomentations or cataplasms. The fumes of the seeds heated in the bowl of a tobacco-pipe were formerly inhaled to allay toothache.

HYPER, *hi'-per* (Gr. *huper*, over, beyond), a Greek preposition, which is conjoined with other words in order to denote excess, or anything beyond, or over and above, the original quality of the word to which it is added. The term *hypercriticism* is an instance of the manner in which the preposition is applied, and the sense in which it is interpreted.

HYPERBOLA, *hi-per'-bo-lă* (Gr. *huper*, above, and *bolé*, from *ballein*, to throw), the name of one of the curves that are known as conic sections (*See* CONIC SECTIONS.) It is formed by cutting the cone in a plane that passes through it in a direction parallel to its axis. Thus, in fig. 1, appended to the article on the ellipse (*see* ELLIPSE), OQP and RTS are hyperbolas



HYPERBOLA.

formed by planes passing through the cone ABC, in directions parallel to its axis AZ. In the annexed figure, CAD and EBF are two branches of a perfect hyperbola formed by the passage of a plane through a double cone, or rather through two cones, which are placed together, apex to apex, having a common axis, and their sides inclined to the axis at the same angle. Z is the centre of the hyperbola, X, Y, its foci, and AB its principal axis, or axis major. The difference between the distances of any point in either branch of the hyperbola is always equal to the principal axis; thus XE−YE=XG−YG=YC−XC=AB. The *latus rectum* of the hyperbola is the straight line drawn through either of the foci at right angles to the axis, as EF. The excentricity is denoted by a fraction, of which ZY is the numerator and ZB the denominator. The tangent drawn to any point in the branches of the hyperbola always bisects the angle made by the lines drawn from that point to the foci. The lines KL, MN, passing through the centre Z, are asymptotes to the curve. (*See* ASYMPTOTE.)

HYPERBOLE, *hi-per'-bo-le* (from Gr. *huperballo*, I throw beyond, exceed), a figure used in Rhet., which signifies more than it is intended to represent to the hearer or reader. When expressions are made use of and assertions made which might be deemed incredible or beyond belief, in order to induce credibility in some fact wanted to be proved, the argument may be said to be supported by hyper[illegible] is well observed, exaggeration is but hyperbole applied to narrative, in order to produce a better impression than would be gained by plain facts alone.

HYPERBOREAN, *hi'-per-bo'-re-ăn* (from Gr. *huper*, beyond, and *boreas*, the north), a designation applied to people who dwell in countries very far north. The ancients gave this denomination to the people and places to the northward of the Scythians, as their knowledge of the localities and the inhabitants did not extend beyond the country belonging to that nation. According to this argument, therefore, hyperboreans are Laplanders, Samoiedes, and the Russians who dwell about the White Sea.

HYPERICACEÆ, *hi-per-e-kai'-se-e*, in Bot., the St. John's Wort fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, consisting of herbs, shrubs, and trees, having the following diagnostic character:—Leaves usually opposite, simple, exstipulate; flowers regular; sepals and petals hypogynous, with a quaternary or quinary distribution; the former with an imbricated æstivation, the latter unequal-sided, commonly marked with black glands, and having a contorted æstivation; stamens hypogynous, usually numerous and polyadelphous, rarely few, and then distinct or [illegible], anthers 2-celled, opening [illegible], [illegible] several, long, fruit [illegible]-celled, [illegible] genera of *Hypericaceæ*, embracing about 270 species, which are generally distributed over the globe. They have commonly a resinous yellow juice, which is frequently purgative, as in the species of *Vismia*. Some have tonic and astringent properties, as *Hypericum perforatum* and *Androsæmum officinale*; and some again have diuretic properties, as *Cratoxylon Hornschuchia*. Many of the St. John's worts are cultivated in shrubberies.

HYPHÆNE, *hi-fe'-ne*, in Bot., a gen. of palms. *H. thebaica* is the Doum palm of Egypt, sometimes known as the gingerbread tree, from the resemblance of the pericarp of its fruit to gingerbread. Unlike most of the palms, this has a stem forked above. The main stem, instead of developing a single terminal bud, develops two buds, each of which produces a branch. Each branch again develops two other buds at its apex in like manner; and this mode of growth is continued with the successive branches.

HYPHEN, *hi'-fen* (Gr. *huphen*, together with), a mark, or short line, written thus (-), and placed between two words, in order to show that they are connected together and form a compound word; as, *pre-occupied, four-leaved*. In writing and printing, the hyphen is used to connect the syllables of a divided word, and is placed after the syllable that closes a line, denoting the connection between that syllable, or part of a word, with the first syllable in the next line.

HYPOCHLOROUS ACID, *hi'-po-klo'-rus*, in Chem., ClO, equivalent 43·5, spec. grav. 2·977, combining volume 2.—Hypochlorous acid is formed by pouring a current of perfectly dry chlorine through a tube filled with well-dried oxide of mercury, procured by precipitation from a solution of corrosive sublimate, by means

of potash. A gas is produced, which may be collected as a deep red liquid in a receiver, kept cool by a mixture of ice and salt. It boils at about 68°, emitting a vapour of a deeper colour than chlorine. It is easily decomposed with explosive violence, by the mere heat of the hand. Water dissolves 200 times its bulk of hypochlorous acid, forming a pale yellow solution. When concentrated, it is easily decomposed, the action of light being sufficient to eliminate chlorine from the compound. With bases it forms the hypochlorites, which are possessed of powerful bleaching properties, in fact, it is now the generally received opinion, that the chloride of lime owes its bleaching power to a certain portion of hypochlorite of lime, which it contains.

HYPOCHONDRIASIS, *hip-o-kon-dri'-ă-sis*, in Med., is a disease characterised by extreme sensibility of the nervous system, leading the patient to believe himself to be suffering from some terrible and imaginary disease, or to be much worse than he really is. The ideas of such persons often partake of the most extravagant character. He may fancy that he is immensely tall, or inordinately small; that he is heavy as lead, or light as a feather; that he is composed of glass, or is a lump of butter. They are all extremely timid, and their fears are exercised upon trifles, or are altogether groundless. They dwell constantly upon their own sufferings, and are usually morose, peevish, suspicious, and misanthropic, and frequently suspect their nearest and dearest friends of designs upon their life. The causes of this disease are various, arising as it does usually from an impaired condition of the nervous system. Young men of studious habits are very apt to suffer from this disease. Those too, who, from want of occupation and a due amount of exercise, acquire a luxurious habit, often fall a prey to it. The cure must of necessity vary somewhat according to the nature of the disease. In general, the great thing is to withdraw the patient's mind as much as possible from himself. For this purpose, cheerful society and change of scene should be adopted. The system ought to be strengthened by tonics and exercise in the open air. If it arise from idleness and luxury, the great cure is plenty of active exercise and a spare diet. In all cases, the state of the digestive organs should be attended to, and the bowels kept in a strictly normal condition.

HYPOGYNOUS, *hi-poj'-e-nus* (Gr. *hupo*, under; *gune*, female), in Bot., a term applied to the stamens when they are free from the calyx and pistil, and arise from the thalamus or torus below the latter organ: this is the normal position of the stamens, and may be observed in the poppy and ranunculus. The term is also applied to the corolla when it arises from below the pistil and free from the calyx. The insertion of the stamens is always regarded as the same as that of the corolla, so that when the former organs are epipetalous, their insertion with regard to the pistil depends upon the point where the corolla itself becomes free; thus, in the primrose the stamens, though attached to the corolla, are said to be hypogynous. The name *Hypogynæ* has been given to a subdivision of the *Petaloideæ*, from the perianth being free and the ovary superior. (*See* classification in article BOTANY.)

HYPONITRIC ACID, *hi-po-ni'-trik*, in Chem., symbol NO_4, equivalent 46 (peroxide of nitrogen, nitrous acid, pernitric oxide).—When binoxide of nitrogen is mixed with oxygen or atmospheric air, red fumes of hyponitric acid are formed. By heating thoroughly dry nitrate of lead in a retort, it evolves hyponitric acid mixed with oxygen. The hyponitric acid may be condensed by passing the mixed gases through a tube surrounded by a mixture of salt and ice. The first portions do not solidify; but if every care be taken to avoid moisture, the latter portions form transparent, colourless prismatic crystals, if the temperature be kept below 4° Fahr. At 15·8° Fahr. it melts into a liquid, which, if the temperature is raised, gradually becomes yellow, and lastly orange, until it reaches 82° Fahr., when it boils, the vapour being a dark yellowish red, turning to black as the heat increases. Hyponitric acid was formerly supposed to give rise to the nitrites, and was thence called nitrous acid; but experiment has proved that, on being added to alkaline bases, it is decomposed, giving rise to nitrates and nitrites.

HYPONITROUS ACID, *hi'-pon-i'-trous*, symbol NO^3 (*nitrous acid*, which *see*).

HYPOPHOSPHOROUS ACID, *hi-po-fos'-fo-rus*, in Chem., symbol PO, equivalent 40.—This acid may be formed by cautiously decomposing the hypophosphite of baryta with sulphuric acid, a solution of that salt being formed when phosphorus is boiled in baryta-water. By evaporation, it forms a sour, bitterish, uncrystallizable syrup, with feeble acid properties. It has been determined with a great degree of certainty by Würtz and others, that the proper formula for hypophosphorous acid is PH_2O_4, instead of PO, as it is found impossible to abstract the two equivalents of water contained in all hypophosphites, without causing their decomposition. The hypophosphites have lately received several important applications in medicine. The salts of soda, potash, ammonia, are formed by adding the carbonates to a solution of hypophosphate of lime, made by boiling four pounds of caustic lime slaked with a gallon of water, with one pound of phosphorus and four gallons of water. The filtered liquid is evaporated and crystallized.

HYPOSTAMINEÆ, *hi-pos-tăm'-e-ne* (Gr. *hupo*, under, and *stamen*), in Bot., the name given to that subdivision of *Corolliflora* in which the stamens are inserted into the thalamus, and do not adhere to the corolla, the ovary being superior. (*See* classification under BOTANY.)

HYPOSULPHURIC ACID, *hi-po-sul-fu'-rik*, in Chem., symbol S_2O_5 (*dithionic acid*).—This acid is formed by passing sulphurous acid through water in which finely-divided peroxide of manganese is suspended. If the liquid is kept cool, hyposulphate of manganese is formed. By adding baryta-water, hyposulphate of baryta is produced, which may be decomposed by sulphuric acid. Its salts are unimportant.

HYPOSULPHUROUS ACID, *hi-po-sul-fu'-rus*, in Chem., symbol S_2O_2, equivalent 48 (*dithionous acid, thiosulphuric acid*).—This acid is formed in combination with soda by fusing equal parts of carbonate of soda and sulphur, dissolving the impure sulphide of sodium formed, and passing through the solution a current of sulphurous acid until it ceases to be absorbed. The liquid is filtered and evaporated, and large crystals of hyposulphite of soda are formed. This salt has received important applications as a fixing agent in photography, and as an *antichlorine* in bleaching, to remove the last traces of chlorine from bleached paper or fabrics. The acid has never been isolated; for if a stronger acid be added to any of the hyposulphites, it splits up into $S+SO_2$. The hyposulphites are easily recognized by the property they possess of dissolving chloride of silver, forming with it an intensely sweet solution. Besides the double hyposulphite of soda and gold, which is used in photography under the name of *sel d'or*, the salt of soda is the only one which has received any important application.

HYPOTHENUSE, *hi-p* [illegible] (Gr. *hupo* under, and *teino*, I stretch), a term [illegible] longest side of a right-angled triangle (*see* [illegible]), or, in other words, that side which subtends the right angle. Euclid, in the 47th proposition of his first book, determines the theory by which the square of the hypothenuse is equal to the sum of the squares of the other two sides of a right-angled triangle, which admirable mathematical problem is said to have been discovered by Pythagoras. It is stated in Brande's Dictionary that Cameron, in the notes to his edition of the First Six Books of Euclid, in Greek and Latin, has collected no fewer than seventeen different demonstrations of this celebrated theorem from the plain principles of elementary geometry.

HYPOTHESIS, *hi-poth'-e-sis* (Gr. *hupothesis*, supposition), a term applied to an argument deduced from an allowed fact. For [illegible] as is forcibly observed in the "English Cyclopædia," the sun would disappear if it were deprived of its power of giving light, and also if an opaque body were to be inserted between it and the earth; either of these circumstances would be amply sufficient to explain a total eclipse, and would be the hypothesis from whence we would derive that conclusion. In all mathematical propositions, in which the manner of reasoning by hypothesis is so vitally necessary, there are two things to be taken into consideration,—firstly, the *hypothesis*, and, secondly, the

conclusion; the former being that which is granted, built on supposition, either of which may be the case and the latter being the necessary consequence of reasoning from the data. There are no better examples of this form of argument than those found in Euclid's problems, any of which will serve to illustrate the sense in which the word hypothesis is to be understood. For the instruction of the reader, the following will be amply sufficient:—*If two triangles have two sides of the one equal to two sides of the other, and the angles contained by these sides be equal; then shall the triangles be equal to one another.* Now the first part of this proposition, on which it is based, is the *hypothesis*, and the latter part, which is determined by the former, is the *conclusion*. In a well-written article on the subject in the "English Cyclopædia," the writer observes: "The following mode of argument is known in logic by the name of hypothetical syllogism:—If A exist, Z exists; but A does exist, therefore Z does exist. Or, establish the absolute truth of an hypothesis, and the phenomena which necessarily follow, may be asserted even without experiment. But this we are seldom in a condition to do. The preceding process cannot be converted: if A exist, let Z necessarily follow; Z has appeared, are we then entitled to say that A exists? By no means; for when we prove that Z necessarily follows from A, we do not show that Z follows from nothing but A. But if we can establish the following:—If A exist, Z follows; if B exist, Z follows; if C exist, Z follows; and Z cannot happen in any other way: then, from the arrival of Z, we are entitled to assume that one of the three, A, B, or C, must necessarily exist; perhaps two, and perhaps all three. At the same time, if the existence of the consequence can be denied, the hypothesis is overthrown. If A exist, Z follows; but Z does not happen; then it is perfectly certain that A does not exist. The following summary of the four cases may be more worthy of our readers' consideration than many of them will suspect.—

(1) When A is B, Y is Z; But A is B, } Therefore Y is Z.

(2) When A is B, Y is Z; But A is not B. } Nothing can be concluded Y may be Z on some other grounds; or Y may not be Z, precisely because A is not B, or for some other reason.

(3) When A is B, Y is Z; But Y is not Z, } Therefore A is not B.

(4) When A is B, Y is Z; But Y is Z. } Nothing can be concluded A may be B, and either because Y is Z, or for some other reason; and A may not be B, and there may be some other reason why Y should be Z."

In Physics, hypothesis is applied to a free supposition made to simplify or account for many of the phenomena and natural qualities of the world as we see it. Of all hypotheses that have been made, Kepler's (*see* GEOMETRY), which assumed that all the planets move in elliptic orbits, is one of the most beautiful, as it has been so fully confirmed by after-astronomers and mathematicians, that its truth manifests another strong proof in favour of this mode of argument. To conclude, in the words of Sir John Herschel, "A well-imagined hypothesis, if it have been suggested by a fair inductive consideration of general laws, can hardly fail at least of enabling us to generalize a step further, and group together several such laws under a more universal expression."—*Discourse on the Study of Natural Philosophy*.

HYPOXIDACEÆ, *hip-oks-e-dai'-se-e* (Gr. *hupo*, under; *oxus*, sharp), in Bot. the *Hypoxis* fam., a small nat. ord. of herbaceous *Monocotyledones*, closely allied to *Amaryllidaceæ*, from which they are distinguished by their habit, their dry harsh leaves, by the outer divisions of the perianth being of coarser texture than the inner, by their seeds being commonly strophiolate, and especially by having an embryo with the radicle remote from the hilum. There are four genera, embracing about 60 species, natives of the warmer regions of the globe. The fleshy roots of some species are eaten.

HYSTERIA, *his-te'-re-ă* (Gr. *hustera*, the womb), in Med., is a nervous affection to which females are particularly subject, and which is generally connected with uterine irregularities. It occurs most frequently with persons between the ages of fifteen and forty-five or fifty, and is most common with single women of weakly constitution and who lead sedentary lives. This complaint appears in such variety of forms, and simulates such a variety of diseases, that it is scarcely possible to give a just character or definition of it. The attack is usually preceded by dejection of spirits, anxiety of mind, difficulty of breathing; a ball is felt advancing upwards from the stomach into the throat, and threatening to stop the passage of the air; then the trunk and limbs of the body become violently convulsed, the patient sobs and cries, and occasionally bursts out into fits of laughter. After a time, these symptoms gradually cease, a quantity of wind is evacuated upwards, with frequent sighing and sobbing, and the woman recovers the exercise of sense and motion without any recollection of what has taken place during the fit,—feeling, however, a severe pain in her head and a soreness all over her body. A fit of hysteria may last from a few minutes to several hours, or even days. It is to be distinguished from an epileptic fit by the absence of foaming at the mouth, by the sobbing and crying, by the milder expression of countenance, and by its being gradual, and preceded by the sensation of a ball. Hysteria assumes various other forms; as palpitations of the heart and difficult respiration; pains in different parts, as the head, left breast, &c.; different forms of paralytic affections, &c. The hysteric fit, however alarming and dreadful it may appear, is rarely accompanied with danger, and never terminates fatally unless it passes into epilepsy, or the patient be in a very reduced state. During the paroxysm, the first care is to see that the patient do no injury to herself, by striking her head or hands against any hard substances, nor to others by biting. If the fit be slight, it may frequently be arrested by dashing cold water on the face, or by filling the mouth with something of an unpleasant taste, or by applying some stimulating scent to the nostrils. If more serious, the face and neck ought to be freely exposed to the air, the forehead bathed with wet cloths, and a slight purgative administered. In some cases, hysteria is owing to plethora, or fulness of blood; in others to deficiency of it. In the former case, a spare diet, exercise, and occasional purgatives, are recommended, with sometimes the actual abstraction of blood; in the other case, the system is to be kept up and sustained by nourishing diet and tonics, particularly iron. The patient's mind is to be kept as cheerful and tranquil as possible, by agreeable company; and all tendency to excesses or irregularities kept in check. The great cause of the prevalence of this disorder among our young females is owing to the defective physical and mental training to which they are subjected. Were their physical frames developed and strengthened by proper exercise, and their mental powers kept in proper subjection, there would be much less of hysteria.

I.

is the ninth letter, and the third vowel, of the English language. It is pronounced by throwing the breath suddenly against the palate as it issues from the larynx, with a slight hollowing of the tongue, and nearly the same opening of the lips as in pronouncing *a* or *e*. In different countries the pronunciation of this letter varies considerably. In Italy, France, and other countries, it is pronounced similarly to the English *e*. In England its sound varies; in some words it is long, as *might*, *fine*; and in others short, as *prince*, *tin*; in others, again, it is pronounced like *y*, as in *union*, *farrier*; and in a small number of words it is pronounced like double *e*, as in *magazine*. The letter *ι* (*iota*), in the Greek language, is the simplest of the alphabetical characters. Used as a numeral, the letter I signifies *one*, and represents as many units as it is times repeated; thus, I. one, II. two, III. three; and when put before a higher numeral, it subtracts itself; as, IV. four, IX. nine; and so on: when, however, it is

placed after a higher numeral, it adds itself; thus, VI. is 5+1, or six; VII. is 5+2, or seven; and VIII. is 5+3, or eight. In Roman coins the I was the mark of the *as* in value and weight; and as an initial letter in inscriptions, it stood for *idus*, *imperator*, *imperii*, *indulgentia*, *inscius*, &c. The dot over the *i* originated in the 14th century.

IAMBICS, *i-am'-biks*, a species of verse used by the Greek and Latin poets, and originally composed of a succession of iambi (⌣ —). The derivation of the word has never been ascertained, but, according to Aristotle, the iambic measure was first employed in satirical poems called *iambi*, which appear to have been acted dramatically. Amongst the Greek tragic poets, the iambic is the measure most commonly used. They consisted of three entire metres, or six feet, and were consequently called the tragic *trimeter acatalectic*. Although, as stated above, this species of verse originally consisted of iambi only, in time other feet were introduced into the metre. In the annexed table is a list of the variations admitted:—

A tribrachys, it will therefore be observed, was admitted into all places except the last; a spondee in the first, third, and fifth; a dactyl in the first and third; and an anapæst in the first. The anapæst, in proper names, was also introduced in every place of the verse except the last, with this restriction, that the anapæst should be contained in one word. In the comic trimeter, the same number of feet is allowed as in the tragic; but in it a dactyl is allowed in the fifth place, and an anapæst, in common words, in every place but the last. For a full account of the iambic metres, the reader is referred to Hermann's "Elementa Doctrinæ Metricæ," and Porson's editions of the tragedies of Euripides. In modern European languages, verses composed of five iambic feet form a favourite metre. Such verses are much used in the lighter French poetry; and in serious composition it is ordinarily used by the English, Germans, and Italians.

IBEX, *i'-beks* (Lat. *Capra Ibex*), an animal belonging to the fam. of the *Capridæ*, of which it was thought by Cuvier to be the distinguishing type and parent stock. Its characteristics are similar to others of the Capridæ, and will be found given under the article GOAT. The ibex is sometimes termed the *steinbok*, and is found principally inhabiting the Alps, the Carpathian mountains, and the Pyrenees, in Europe, of which continent it is a native. Its horns are extremely [illegible] of the ibex is gregarious, and, consequently, it is always met with in small flocks; and the animal is likewise remarkably swift, and able to climb the highest mountains and most precipitous ascents. When pursued, it is uncommonly fierce, and will turn on its hunters with the greatest courage, and endeavour to hurl them down the precipices which it affects. It is said, also, to have the faculty of throwing itself down from the most fearful heights and alighting in safety on the ground, as it receives the shock of descent on its horns, which, by their elasticity, preserve it from any injury; the pursuit of the ibex is, therefore, extremely difficult, and, to say the least, hazardous.

IBIS, *i'-bis*, a gen. of grallatory birds, common throughout Africa, one of whose most remarkable species is the *Ibis religiosa* of Cuvier. This latter variety arrives in Egypt about the time that the inundation of the Nile commence, and it emigrates from thence to Ethiopia about June, when the waters have subsided. It is about the size of a fowl, the head and neck being bare and the body white, while the long quills of the wings are tipped with shining ashy black. It was worshipped by the ancient Egyptians, who considered it a sacred bird, and mummies of it are being continually discovered in large numbers in the catacombs of Memphis. The principal other variety is the glossy ibis (*Ibis falcinellus*), which is nearly two feet in length, and proportionate in size. The natural characteristics of the ibis are as follows:—Beak arched, long, slender, thick at the base, where it is quadrangular, and furnished with an obtuse tip; nostrils extending from the root to the tip of the beak, and linear, dividing it into three portions; head and throat bare; legs long and four-toed, the front webbed at their base as far as the first joint; the hind toe very long, and all provided with claws.—*Ref.* Cuvier's *Natural History*.

ICACINACEÆ, *i-kă-sin-ai'-se-e*, in Bot., the *Icacina* fam., a nat. ord. of *Dicotyledones*, in the sub-class *Thalamifloræ*, consisting of evergreen trees and shrubs, natives of tropical and nearly tropical countries. This order was formerly included in *Olacaceæ*. The plants are little known.

ICE, *ise*, the familiar and also the technical term for water in the solid state. Water, on being cooled, contracts until the temperature has fallen to about 39° Fahr., when it begins to expand. At the freezing-point, 32°, under ordinary circumstances, ice is formed, which, in consequence of the continued expansion, has only 0·93 the density of water at 39°. The ice, therefore, floats upon the surface. The increase of volume in the formation of ice is the cause of the splitting of stones and rocks by the frost; for water penetrates into the crevices, and there becomes frozen. The great expansive force of ice was experimentally investigated by Major Williams. He filled a mortal with water, and having rammed a wooden plug tightly into the muzzle, placed it in air at a temperature considerably below freezing-point. When the water froze, the plug was forcibly driven out to a distance of 400 feet. Ice has the peculiar property of re-uniting by the contact of adjoining surfaces, after having been broken into fragments. (*See* REGELATION.) The phenomena attending the conversion of water into ice are noticed under the heads FREEZING, LATENT HEAT, TEMPERATURE, and WATER.

ICEBERG, *ise'-berg* (Ger. *eis*, ice; *berg*, mountain), the name given to a mountainous mass of ice floating in the sea. Some icebergs are formed by the accumulation of ice and snow on the surface of the water; others are produced by the descent of glaciers into the sea. When numbers of icebergs freeze together, they form what are called "fields" or "packs," which are often of great extent, stretching across the ocean as far as the eye can reach, and often rising in perpendicular cliffs from 80 to 100 feet above the water. Solitary icebergs are also often of vast dimensions, and instances are given, both in Arctic and Antarctic voyages, of floating islands of ice several miles in circumference, rising from 40 to 200 feet above the sea-level, and loaded with blocks and shingle. As they are floated by the polar currents to warmer latitudes, they melt away, dropping their burdens of boulder and rock débris on the bottom of the ocean. Geologists regard the water-worn blocks, the gravel, and shingle of the "boulder-clay" as the deposits of ancient icebergs.

ICE-BLINK, an appellation given by seamen to a luminous appearance seen near the horizon in northern latitudes. It is caused by the light being reflected by the fields of ice, and it is seen long before the ice itself which causes it can be observed.

ICE-HOUSE, a term applied to cellars constructed for the purpose of preserving ice in warm temperatures for a considerable time. Cellars made for this object are surrounded with thick walls, and either arched over or provided with a conical wooden roof. The portion of ice which melts can be removed either by means of a drain under the cellar, or may be raised to the surface, and drawn off by a pump. The roof of the cellar may be covered with earth to any required extent in very hot climates. In all cases, air should be carefully excluded from ice-houses. The best soil for the foundation of an ice-house is chalk, since it permits the water from the melting ice to percolate through. In America, vast buildings are erected above ground for the storing and preserving of ice. Some of them are two hundred feet long, and resemble huge barns. Around Forest Pond, in Massachusetts, are nearly fifty of these immense structures.

ICELAND MOSS. (*See* CETRARIA.)

ICELAND SPAR, in Min., [illegible] crystalline calc-spar, possessing the prope[illegible] [illegible] doubl[illegible] refracting objects seen through its mass: first found in Iceland.

ICE-PLANT. (*See* MESEMBRYANTHEMUM.)

ICE-SAWS.—Large saws used for cutting through the i[illegible]e, for relieving ships when frozen up. The vessels employed in the Greenland fisheries, and others that navigate the Polar seas, are regularly furnished with these machines, as the li[illegible] [illegible] the crew not unfrequently depend on the ex[illegible] with which a passage can be cut so as to disengage the vessel before the further accumulation of ice renders it an impossible undertaking. The saw, with a weight suspended to it, is introduced by means of a hole broken through the ice, and is suspended by a rope passed over a pulley fixed to a triangle. A party of a dozen or more men run out and back again with a rope, and thus move the saw up and down till it has cut its way so far as to hang perpendicularly from the pulley. The triangle is then moved a foot or two farther, and the sawing recommences,—the services of the whole crew being required in this laborious undertaking. In Hood's machine the saw is suspended by a slight sledge, and is worked by the power of only two or three men at the end of a lever; a bar, called a propeller, is fixed on the lever between the fulcrum and the saw, the other end resting on the surface of the ice, and so adjusted, that each motion of the lever shall produce a cut of a given length, and, at the same time, by means of the propeller, push the sledge on, so that the teeth of the saw shall always be in contact with the ice. Fig. 1, Plate LXV., gives a side elevation of the machine. *a a a* is a sledge of open framework, resting on the surface of the ice; *b*, a transverse bar passing through the lever *c c*, and forming the fulcrum, on which it moves. This lever has a cross handle, as represented in perspective in dotted lines; *e*, a clamp, or brace, consisting of two cheeks, one on each side of the lever, loosely pinned at the top to the lever, and at the bottom to the saw *f*; *g*, a clamp similar to *e*, by which the weight *d* (which is the shape of a double convex lens) is hung to the lower end of the saw; *i*, the propeller, an iron bar terminating below in two claws, and at top in a fork, and suspended on the lever by means of a transverse pin *k*; *l*, a weight hung to the propeller at *m*; *n*, a transverse bar, limiting the motion of the handle end of the lever in an upward direction. It should be understood that there is a duplicate frame, similar to that brought in view, on the other side of the machine, about eighteen inches apart, and connected by transverse bars. To prevent the lever from swerving laterally, there are at the handle ends two upright bars between which the lever moves. The saw, after having once entered the ice, will only require from two to four men to work it, and it should not be taken out of the ice till after the distance required to be cut through is accomplished. The saw can be guided by the lever in any direction, so as to cut the ice into pieces most convenient for removal, either by pushing them under the adjacent floor of ice, or by dragging them out of the ship's track into clear water.

ICY-SPAR, in Min., this name is applied to transparent crystals of felspar found in certain lavas.

ICE-TRADE.—The exportation of ice from cold to warm climates, as an article extensively used for a variety of economical purposes, has greatly increased since Mr. Tudor, of Boston, sent out the first cargo in 1806. For twenty-five years he continued to devote himself to the ice-trade, and after numerous misfortunes, established it as one of the most lucrative in the United States. In 1854, 156,540 tons were exported from Boston alone. Of the ice thus exported from America, comparatively a small quantity is shipped for Britain; the largest quantity imported into this country is received from Norway, probably the only other country which carries on a trade in ice. In America during December and January, when the ice is forming, it is kept as free of snow as possible. Holes are occasionally pierced in the forming ice to accelerate its formation, by allowing the water to overflow. After being carefully cleared of snow with scrapers made of wood, and of the snow-ice by means of [illegible] iron scrapers, the ice is marked out by an iron plough into squares of about five feet each. The "cutters" follow in these tracks; and the ploughs, scrapers, and cutters are all drawn by horses. The square pieces, after having been disengaged by means of hand-saws, are then ready to be floated to the shore. Four hundred tons can thus be cut and stored away in [illegible] by forty men and twelve horses in one day. The [illegible] Lake Ice Company have an ice-store which [illegible] 10,000 tons of ice. At first the [illegible] of [illegible] only were used in securing [illegible] but as the trade became [illegible] important, other [illegible] and [illegible] methods were adopted, and [illegible] were brought forward, or [illegible] the increased [illegible] of the business required. [illegible] More ice is now secured in one [illegible] day than would have supplied the whole trade in 18[illegible]. Ordinarily, before there has been cold enough to [illegible] ice of [illegible] thickness, snow falls on its surface. If this occurs when the ice is four or more inches in thickness, and the snow not heavy enough to sink the ice, it can be removed by using horses attached to the "snow-scraper"; and, under such circumstances this is the method in common use. But if snow falls so heavy as to bring the water above the surface of the ice, it is removed after it has congealed into snow-ice with the "ice-plane." These preliminary expenses are [illegible] very great; frequently, after much expense has [illegible] incurred to remove a body of snow or snow-[illegible] weather becomes warm, and spoils the ice on whi[illegible] so much has been expended; and, on the other hand, if it is not done, and the cold continues, there will be little or no increase of thickness to the ice, which is equally a disaster. When the ice is made up for transportation, it is employed in ships as ballast, for which [illegible] is carefully cut up into blocks to fit the hold, and covered with sawdust, straw, and charcoal dust—all non-conductors of heat,—under cover of which it is conveyed on the voyage. When the ice is regularly shipped as a cargo, being cut in blocks, it is packed on board the vessel in thin air-tight boxes, with straw or hay. In this manner it is conveyed without loss. The machinery employed for cutting the ice is worked by men and horses in the following manner:—From the time when the ice first forms it is carefully kept free from snow, until it is thick enough to be cut. That process commences when the ice is a foot thick. A surface of some two acres is then selected, which, at that thickness, will furnish about 2,000 tons; and a straight line is then drawn through its centre, from side to side each way. A small hand-plough is pushed along one of these lines until the groove is about three inches deep and a quarter of an inch in width, when the "marker," fig. 2, Plate LXV., is introduced. This implement is drawn by two horses, and makes two new grooves parallel with the first, 21 inches apart, the gauge remaining in the original groove; the marker is then shifted to the outside groove, and makes two more. Having drawn these lines over the whole surface in one direction, the same process is repeated in a transverse direction, marking all the ice out into squares of 21 inches. In the mean time the "plough," fig. 3, drawn by a single horse, is following in these grooves, cutting the ice to the depth of six inches. One entire range of blocks is then cut out with the "ice-saw," fig. 4, and the remainder are then split off towards the opening thus made with an iron bar. This bar, represented in fig. 5, is shaped like a spade, and is of a wedge-like form; when it is dropped into the groove, the block splits off,—a very slight blow being sufficient to produce that [illegible] especially in very cold weather. The labour of sp[illegible] is slight or otherwise, according to the temperature [illegible] the atmosphere. Platforms or low tables of framework are placed near the opening made in the ice, with iron slides extending into the water, and a man stands on each side of this slide with an "ice-hook." With this hook, fig. 6, the ice is caught, and, by a sudden jerk, thrown up the "slide" on to the "platform." On a cold day everything is speedily covered with ice by the freezing of the water on the platforms, slides, &c.; and the enormous blocks of ice, weighing, some of them, more than 200 lb., are hurled along these slippery surfaces, as if they were without weight. Beside this platform stands a "sled" of the same height, capable of containing about three tons, which, when

loaded, is drawn upon the ice to the front of the storehouse, where a large stationary platform, of exactly the same height, is ready to receive its load, which, as soon as discharged, is hoisted block by block into the house by horse-power. This process of hoisting is so judiciously managed, that both the taking up of the ice and the throwing it into the building are performed by the horse. The frame which receives the block of ice to be hoisted is sunk into a square opening cut in the stationary platform, the block of ice is pushed on to it, the horse starts, and the frame rises with the ice, until it reaches the opening in the side of the storehouse ready for its reception, when, by an ingenious piece of mechanism, it discharges itself into the building, and the horse is led back to repeat the process. Forty men and twelve horses will cut and stow away 400 tons a day. In favourable weather 100 men are sometimes employed at once. When a thaw or a fall of rain occurs, it entirely unfits the ice for market, by rendering it and porous, and occasionally snow is imme- followed by rain, and that again by frost, forming *snow-ice*, which is valueless, and must be removed by the "plane." The operation of planing is somewhat similar to that of cutting. A plane, fig. 7, gauged to run in the grooves made by the marker, and which shaves the ice to the depth of three inches, is drawn by a horse until the whole surface of the ice is planed. The chips thus produced are then scraped off, and if the clear ice is not reached, the process is repeated. If this makes the ice too thin for cutting, it is left *in statu quo*, and a few nights of hard frost will add *below* as much as has been taken off *above*. The uses of ice are various in all parts of the world; either for cooling wines and other beverages, or for packing salmon, or for confectionary purposes. In warm climates, it is prized as a luxury; and in Bengal and other hot countries, artificial means are regularly used for its manufacture. Throughout the states of North America, the ice-trade gives employment to a large number of the working classes during a period of the year when all ordinary avocations are suspended. The ice-farms of New York and Massachusetts, in the working of which a large number of hands are employed, are considered equal in value to the rice-crop of Georgia; and the whole capital invested in the trade is about $1,500,000.

ICH DIEN, *ik deen* (Ger., I serve), the motto of the prince of Wales. Besides the coronet, this prince has a distinguishing mark of honour, called the prince of Wales's feathers. This consists of a plume of three ostrich-feathers, with an ancient coronet; under which in a scroll is the motto "ICH DIEN." This device was first assumed by Edward the Black Prince, after the famous battle of Cressy, in which he slew with his own hand John, king of Bohemia, the stipendiary of the king of France, in whose wars he was then serving. It was from the head of this Bohemian potentate that Edward, then prince of Wales, took such a plume and motto, which have ever since been borne by every succeeding Prince of Wales in remembrance of the event.

ICHNEUMON, *ik-nu'-mon* (Gr. *ichneumon*, from *ichneuo*, I track; probably because it tracks the footsteps of the crocodile), a name applied in Zool. to a genus of quadrupeds and a family of hymenopterous insects. The name of *Herpestes* is now usually given to the mammalia. The genus has the following characters:—Feet short, with five demi-palmated toes, armed with claws, which are slightly retractile; tongue furnished with horny papillæ; ears small; a voluminous simple pouch, which does not contain odoriferous matter, and at the bottom of which the vent is pierced. Body very much elongated, with a long tail, strong at its base. The species of the genus *Herpestes* are found in Asia and Africa. The *Herpestes Ichneumon*, or *Ichneumon Pharaonis*, has fur of a chestnut-brown and yellow colour, each hair being annulated with those two colours; the feet and muzzle are black, or deep chestnut, and the tail is terminated by a tuft of long hair. It appears to have been one of the sacred animals of the ancient Egyptians; and according to Herodotus, it was buried in "holy repositories." Although many fabulous feats performed by this animal, in destroying crocodiles, are narrated by ancient writers, they would all appear to be founded upon its industrious searching for the eggs of that reptile, which tends materially to check its reproduction. The ichneumon, however, preys upon the eggs of other animals besides those of crocodiles. In Upper and Lower Egypt, during the inundations of the Nile, it is frequently found in gardens and near the villages; but in the dry season it resorts to the open fields and to the banks of the river. It feeds on plants, eggs, and fowls, killing the latter in the villages at night. In Upper Egypt, it searches for the eggs of the crocodile, which he hid in the sand on the shore, and eats them. The ichneumon can be easily tamed, and taught to go about a house like a cat. It makes a growling noise, and barks when angry. A grey ichneumon (*Herpestes griseus*) has been known to kill twelve full-grown rats, which were let loose in a room sixteen feet square, in less than a minute and a half. It also destroys small reptiles.

ICHNEUMON FLY.—The genus of insects called ichneumons belong to the order *Hymenoptera*, section *Terebrantia*, and family *Pupivora*, in the arrangement of Latreille. They are remarkable for the habits of their larvæ, which are parasitic in the bodies of other insects. The perfect ichneumons perforate these bodies by means of their ovipositors, and there deposit their eggs. They have derived their name from this destructive habit, a comparison having been drawn between them and the *Herpestes Ichneumon*, the quadruped above described. The development of these parasitic insects within the body of other insects afforded much speculation among early philosophers, who fancied that occasionally one animal had the power of being transformed into another. The eggs of the genus *Ophion* are of a singular form, being bean-shaped, and attached near one end by a long slender peduncle to the body of the victim. When hatched, the larva retains this position, and thus lives upon the juices of the insect it attacks.

ICHNITES, *ik'-nites* (Gr. *ichnos*, a footprint), in Geol., a term applied to all fossil footprints.

ICHNOGRAPHY, *ik-nog'-ra-fe* (Gr. *ichnos*, and *graphein*, to write or draw), a term used to express the ground-plan of any building, and also applied to the delineation of the same. It is not used in the present day, but it will be found in old works on architecture and county histories, in which views and ground-plans of churches and buildings of interest are often given.

ICHOR, *ik'-or* (Gr.), a term used in Med. to denote a thin, acrid, and sanious discharge from wounds, ulcers, &c. By the ancient Greeks the term signified the divine liquor which flowed from the wounds of the gods.

ICHTHIN, *ik'-thin*, in Chem., the azotised albuminoid principle obtained from the yolk of the eggs of fishes. It corresponds to the vitellin found in the yolk of the eggs of fowls.

ICHTHYODORULITE, *ik-the-o-dor'-u-lite* (Gr. *ichthus*, fish; *doru*, spear; *lithos*, stone), in Geol., a fossil fin-spine. The spines of certain shark-like fishes of the lower coal-measures are often more than a foot long, and exceedingly strong.

ICHTHYOLITE, *ik'-the-o-lite* (Gr. *ichthus*, fish; *lithos*, stone), in Geol., a general term for a fossil fish, or any portion of a fish; as a scale, tooth, or spine.

ICHTHYOLOGY, *ik-the-ol'-o-je* (Gr. *ichthus*, a fish; *logos*, a discourse), that branch of science which treats of the natural history of fishes. For a general description of the features and anatomy of these many-formed animals, the reader is referred to a former article. (*See* FISH.) The science of ichthyology, during many remote ages, consisted, in common with all similar branches of human knowledge, of merely a few partial, unconnected observations. Aristotle, about 330 years before the Christian era, made some progress towards connecting these together as a body of doctrine; but no real advance was made till the middle of the 16th century, when Belon, Rondelet, and Salviani, the true founders of modern ichthyology, made their appearance. These men, instead of merely compiling, like their predecessors, saw and examined for themselves, and made drawings from nature. About the end of the 17th century, Willughby, and the celebrated John Ray, first issued a history of fishes, in which the species were not only accurately described from nature, but distributed in accordance with characters drawn solely

from their structure. [illegible], Artedi and Linnæus, about the middle of the [illegible], completed the work which the others had commenced, by establishing well-defined generic groups, consisting of species well ascertained and accurately characterized. The greatest stride that the science has made since that time is due to the zeal, accuracy, and perseverance of Baron Cuvier, whose great work,—"Histoire Naturelle des Poissons," treats comprehensively of the subject. In none of the greater divisions of the animal kingdom were Cuvier's labours in forming a natural arrangement of the species of more value than in the class of fishes, the lowest of the vertebrata, or those animals which possess a central bony axis, on which the soft parts are sustained, and from which the motive powers diverge. In the lowest known form of fish, the lancelet, the whole vertebral column is merely a pulpy nervous chord, invested by a membranous sheath. The vascular trunks and digestive organs in all the vertebrata are protected by the inferior processes and diverging appendages of the vertebræ; and the type of this division of animals is essentially quadrupedal, though in several groups, one or both pairs of limbs are either rudimental or altogether absent. Deviations from the ordinary type of this nature are principally to be found among the classes of fishes and reptiles. In fishes, these limbs are called fins, the anterior being named the pectoral fins, and the posterior the dorsal fins. The vertical fins are of a different nature. Artedi denominated those fishes which have spinous rays on the back, Acanthopterygians (Gr. *acantha*, a thorn; *pterux*, a wing), and those which have only flexible and jointed rays, Malacopterygians (Gr. *malakos*, soft; *pterux*, a wing). According to Cuvier, the acanthopterygian character assumes a preponderance over all other divisions, and renders them secondary, and incapable of being placed in opposition to it. The malacopterygian families are distinguished by more marked differences and characters than the former; some are both naturally and distinctly limited, so that each is not only clearly separated from the other, but also retains within itself a great resemblance in the details. The history of fishes commences with the Acanthopterygians, which constitute one immense family. Amongst them are many varieties, useful as articles of food, and of considerable value to man in a commercial point of view. The Malacopterygians include the abdominal fishes, which have the ventral fins situated behind the pectoral. These are mostly fresh-water fishes, such as the carp, pike, and salmon: the herrings are also of the same nature. The sub-brachial and apodal fishes have cartilaginous fins. One of the best modern classifications of fishes is that of Professor Müller, who finds characters which he considers to be of the highest importance in the vascular system. There is in most fishes, close to the ventricle, a thick muscular swelling of the commencement of the arterial system, which might almost be called a third chamber of the heart. The blood is prevented from regurgitating into the ventricle, on the contraction of this bulb, by valves. The number of these openings, and the presence or absence of the thick muscular coating of the bulb, furnish distinct characters for the different groups. Müller says that these characters are so constant that he is unacquainted with any others, either anatomical or zoological, equal to them in certainty. The Plagiostomi, or cartilaginous fishes, have three or more rows of valves within the muscular valve. In the Ganoids, a still greater number is present; but in the large group formed by the osseous fishes, after the ganoids have been removed from [illegible]

[illegible] six sub-classes of fish [illegible], Ganoidei, Elasmobranchii, Marsipobranchii or Cyclostomi, and Leptocardii. In Professor Owen's modification of this arrangement, these sub-classes are not preserved, the class being subdivided into nine orders, and again into sub-orders. The first order, Dermopterous fishes (Gr. *derma*, skin; *pteron*, a wing) possess cutaneous vertical fins, in which the muscoid rays are soft and delicate, or altogether imperceptible. The species are not numerous, and are of a vermiform shape. They are divided into the following sub-orders:—1. Pharyngobranchs. 2. Suckers, to which several species belong, one of which the New Zealanders roast and eat: the lamprey belongs to the same sub-order. 3. Ribbon Apodals, delicate, semitransparent, and scaleless fishes, which are inhabitants of all the oceans.—The second order, Malacopterous fishes, have a well-ossified skeleton, and a head that is at once recognized as such; but with the bones of the face less developed than in more highly organized fishes. They are divided into the [illegible] sub-orders:—1. Serpentiform Apodals, which [illegible] the Anguilidæ. The eel (*Anguilla vulgaris*) [illegible] this country to the size of two or three feet, and is sometimes said to reach five or six feet in length. 2. Apodals, with articulated fin-rays. The best-known species of this sub-order is the *Gymnotus electricus*, or electric eel. It is remarkable for the violence of its electric shocks, which are often powerful enough to stupefy a man or horse. 3. Malacopterous Abdominal fishes. The species of this family are so numerous and so much alike, that considerable confusion prevailed concerning those described by early writers. The best known fishes of this tribe are the herring, pilchard, anchovy, salmon, trout, grayling, pike, carp, tench, bream, and chubb. The large family of the Siluroids complete the race of malacopterous fishes. They have an air-tube to their swim-bladder, and some of the rays of their fins are firmer, stouter, and nearly as hard as those of acanthopterous fishes.—The third order consists of the Pharyngognaths. In all these fishes, the lower pha[illegible]eals are united to form one bone. They are [illegible]ded into two sub-orders,—the Malacopterygii and the Acanthopterygii: amongst the former, the flying-fish is best known.—The fourth order is that of the Anacanths.—The only difference that exists between this order and that of the Acanthopterous fishes is the absence of spinous or pungent rays in the fins. It is divided into two sub-orders:—1. Ophidiidæ, containing the cod, haddock, dorse, whiting, and common hake. 2. Thoracici, which numbers the Echeneis and the Flounder family.—The Acanthopterous fishes form the fifth and most extensive of all the orders, and consist of twenty-four families.—The sixth order is composed of Plectognathous fishes (Gr. *plektos*, interlaced; *gnathos*, jaw). The bones of the Plectognaths differ in some degree from those of the great mass of osseous fishes, and there are fewer pieces in their skeletons. The upper jaw is immovable, and the dermal productions, scales, spines, roughness, and osseous plates, differ from ordinary fish-scales. The order consists of three families.—Fishes of the seventh order, Lophobranchs (Gr. *lophos*, a tuft; *branchia*, gills), possess an osseous skeleton and complete and free jaws; but the ultimate division of their branchiæ, instead of being pectinated, is divided into small tufts, which are ranged by pairs along the branchial arches. They are thus, as it were, encased in mail armour; and this, together with their angular form, gives them a singular aspect. The order contains three families, among the most interesting members of which are the sea-horse fish and the pipe-fish.—The eighth order is that of the Ganoids. The scales of the Ganoids are generally of a rhombic or quadrangular form, seldom rounded in outline, and always coated on the surface with a layer of enamel. The living ganoids have all bony skeletons, but in many of the fossil ones the skeletons have been cartilaginous, like that of the sturgeon. There are three families belonging to the order.—The Sirenoids form the ninth order, of which two distinct species are known,—one found in the river Amazon, and another, called the *Lepidosiren annectans*, which inhabits the river Gambia. Very little is known about the former, but the latter has been frequently examined, and has given rise to much discussion among naturalists as to whether it ought to be classed with reptiles or fishes. After the floods at the conclusion of the rainy season have begun to retire, this fish is left behind in the mud, which the tropical sun soon converts into a hard cake. An aperture, however, is left to admit air, and the Lepidosiren remains torpid in its chamber till the water again overflows the country.—The tenth order consists of the Chondropterygians, or cartilaginous fishes, which contains the false shark.—The Plagiostomic fishes (Gr. *plagios*, sideways; *tomos*, a cut) or Sharks, form the

eleventh order, and are divided into two sub-orders,—the Squali and the Raiæ. The Squali, or sharks, are of several varieties: the Scyllidæ, or dog-fishes; the Carcharidæ, which are armed with teeth arranged in a linear series, so as to form a sharp saw, each tooth in the majority of species being also serrated on the edge. They have been known to divide the body of a man in two at one bite. Of the *Galeidæ*, or *Topes* and *Hounds*, there are two British examples, called by the fishermen of different localities "penny-dog" and "miller's dog." The Lamnidæ furnish the *Lamna cornubica*, the most formidable of the sharks met with in the English Channel. The *Alopecias vulpes* is distinguished from the rest of this sub-order by the great length of the upper lobe of its tail exceeding that of its body. It is often called the "thrasher" by seamen, on account of its attacking the whale and striking it violent blows with its tail. Another family of sharks is the Cestracions, of which two species have been observed; one near Japan, and the other in the Australian seas. The Raiæ, or sub-order of Rays, is familiarly known by the name of skates. The general character of its form is the extreme depression of its body and the lateral expansion of the dorsal fins: the torpedo belongs to this sub-order. The study of the geographical distribution of species is very important in its connection with ichthyology. It is especially of importance to a maritime nation like our own, anxious to extend her fisheries, thereby not only increasing the supply of a nourishing food, but also fostering and encouraging her school for seamen.—Ref. *Biographia Zoologica*, published by the Ray Society; and the article on Ichthyology, by the late James Wilson and Sir John Richardson, in the *Encyclopædia Britannica*. (*See* Plate LXXI.)

ICHTHYOSAURUS (Gr. *ichthus*, fish; *sauros*, lizard), in Geol., a well-known genus of extinct marine saurians, so called from the combination of fish and lizard characters. The great era of ichthyosaur development was from the middle Trias to the Chalk inclusive, the Lias formation being the chief repository of their remains in England. In this deposit specimens of all ages and of all sizes have been found,—from the fœtus of a few inches to the adult more than thirty feet in length. The following are the most striking peculiarities in the structure of the fish-lizard:—The vertebræ resemble those of fishes in being concave at each end. The cranium resembles that of the crocodile, but is characterized by a remarkably large eye-orbit, furnished with a circular series of bony sclerotic plates,—a structure observable in the eyes of turtles, lizards, and many birds. The teeth, which are extremely numerous, resemble in structure those of the crocodiles, but are implanted in a deep continuous groove, and not in distinct sockets. The locomotive extremities are similar to the paddles of the whale; but they are four, instead of two, in number. From the form and position of masses of crushed and apparently half-digested fish-bones and scales in the abdominal cavity, it is concluded that the ichthyosaurs preyed upon fish; and from the shape of their *coprolites*, or fossil excrements, it is obvious that their intestinal canals were furnished with spiral valves, as in the sharks. In one or two instances, very small, and to all appearance fœtal specimens, have been found within the pelvic cavities of large ichthyosaurs; and from this circumstance it has been inferred that these extraordinary creatures, like the whales, were viviparous.

ICHTHYOSIS, *ik-the-o'-sis* (Gr. *ichthus*, a fish), a disease of the skin, which takes its name from the surface of the cuticle suggesting the idea of the scaly skin of a serpent or fish. It is distinguished from lepra and psoriasis by the absence of deciduous exfoliations, distinct or partial patches, and the constitutional disorders which more or less accompany those diseases. It is generally confined to patches in the armpits and on the breast or chest; but sometimes it attacks the face.

ICHTHYS, *ik'-this* (Gr. *ichthus*, a fish), a word found on many ancient tombstones, urns, seals, rings, &c., belonging to the early ages of Christianity. As each character forms an initial letter in the Greek words *Iesous Christos, Theou Uios Soter* (Jesus Christ, the Son of God, the Saviour), the word is supposed to have had a mystical meaning. It would appear as if this interpretation were correct, when the reverence with which the fish was symbolically regarded by the ancients is considered. Many signs and ceremonies were adopted by the Christians, with some change of meaning, from the religious rites of the nations amongst whom they dwelt.

ICICLE, *i'-sik-kl* (Sax. *ises-gecl*), a pendent conical mass of ice, formed by the freezing of water or other fluid as it flows down an inclined plane, or collects in drops and is suspended. In the north of England it is called *ickle*.

ICONOCLASTS, *i-kon'-o-klästs*, Gr. *eikon*, an image, and *klao*, I break), literally, breakers of images. In Ecclesiastical History, the violent opponents of the veneration of images in the 8th and 9th centuries. In the Greek church no carved, sculptured, or molten images of holy persons and things are allowable; but pictures are employed. In the Roman Catholic church both pictures and images are allowed.

ICONOGRAPHY, *i-ko-nog'-rä-fe* (Gr. *eikon*, an image or representation, and *graphein*, to write).—In an extended sense, the word iconography is applied to the description of any figures found in paintings and sculpture, as well as monumental records of ancient date; but in its restricted signification it is confined to descriptions and drawings of any sculptured images or paintings of the human form, animals, and inanimate objects, that are found in buildings and their appurtenances, and furniture, that are devoted to ecclesiastical purposes. This is more properly termed Christian iconography, and embraces all objects connected with Christian art from the earliest times, as far as the close of the 15th century. When the word is understood in this sense, it is a branch of ecclesiology.—*Ref.* Didron's *Christian Iconography* (Bohn); Jameson's *Legendary and Sacred Art*.

ICONOLOGY, *i-kon-ol'-o-je* (Gr. *eikon*, an image, and *logos*, word, or discourse), a description and explanation of allegorical figures, symbols, emblems, and visible representations, or embodiments of abstract qualities.—*Ref.* Pistrucci's *Iconology*.

ICOSAHEDRON, *i-ko-sa-he'-dron* (from Gr. *eikosi*, twenty, and *hedra*, base), one of the five regular solids, according to the Platonic theory, and composed of equilateral and equal triangles. As it is composed, therefore, of twenty equal and similar pyramids, whose vertices all meet in the same point, the content of one of these multiplied by twenty will give the whole content of the icosahedron. (*See* GEOMETRY.)

IDEA, *i-de'-ä* (Gr. *idea* and *eidos*; Lat. *forma*, *species*), in Phil., denotes in general whatever is the immediate object of thought. In the Platonic philosophy, however, the word possesses a different and a higher signification. According to him, ideas were the patterns after which the Deity made or fashioned the phenomenal or material world. He held that all things consisted of matter and form, and that the matter of which all things were made existed from all eternity, without form; but he believed that there also existed eternal forms of all possible things which exist without matter, and to these eternal and immaterial forms he gave the name of ideas. By Descartes and subsequent philosophers, the term idea has been employed to signify all our mental representations, all the notions which the mind frames of things; and when, in common language, we speak of having an idea of anything, we mean no more by that expression than that we are thinking about it. By idea, Kant designates every conception formed by the reason and raised above all sensuous perception. These he subdivides into empirical, or such as are partly drawn from experience, and pure, such as are totally free from any empirical element. Another division of ideas is into theoretical and practical. As to the origin of our ideas, some attribute all our ideas to sense; others admit that the earliest notions proceed from the senses, yet maintain that they do not produce the whole knowledge possessed by the understanding; while others deny the senses to be anything more than instruments conveying objects to the mind.

IDEAL, BEAU, *bo i-de'-äl*, an expression applied in the Fine Arts to denote a selection of the finest parts of different subjects united, so as to form one

harmonious whole, of a more complete character than is usually found in nature. In other words, it is "the divesting nature of accident, in the representation of an individual. From the nature of the expression, and its definition, it is clear that it more immediately attaches to the arts of painting and sculpture; in architecture, it is susceptible of refinements, dependent on the selection of examples, upon which, however, a less universal agreement exists."—Brande's *Dictionary*.

IDEALISM, *i-de'-al-izm*, in Phil., is the doctrine that in external perceptions the objects immediately known are ideas. Of this doctrine there are several varieties. Some absolutely deny the existence of all material substances; others regard the real simply as ideal, and judge the material world to be merely assumed from the ideal; while a third class, without denying or asserting the existence of a material world, are content with confessing an ignorance of its nature. "I see a tree. The common psychologists tell me that there are three things implied in this one fact of vision; viz., a tree, an image of that tree, and a mind which apprehends that image. Fichte tells me that it is I alone who exist. The tree and the image of it are one thing, and that it is a modification of my mind. This is *subjective idealism*. Schelling tells me that both the tree and my *ego* (or self) are existences equally real or ideal; but that they are nothing less than manifestations of the absolute, the infinite, or unconditioned. This is *objective idealism*. But Hegel tells me that all these explanations are false. The only thing really existing (in this one fact of vision) is the idea, the relation. The *ego* and the tree are but two terms of the relation, and owe their reality to it. This is *absolute idealism*. According to this, there is neither mind nor matter, heaven nor earth, God nor man. The only real existences are certain ideas or relations. Everything else that has name or being derives its name and being from its constituting one or other of the two related terms, subject and object; but the only thing that is true or real is the identity of their contradiction, that is, the relation itself."—*Ref.* Lewes's *Biographical History of Philosophy*.

IDENTITY, *i-den'-ti-te* (Lat. *idem*, the same), denotes the sameness of one thing with th[illegible] thing under different circumstances. Thus, p[illegible]nal identity is the consciousness that one has that he is identically the same person that he was months or years ago. By absolute identity is meant that the two elements of thought, objective and subjective, are absolutely one, merely different aspects of one sub-[illegible] This is maintained by Schelling and Hegel, and is a species of pantheism.

IDEOGRAPHS, or IDEOGRAPHIC CHARACTERS. (*See* HIEROGLYPHICS.)

IDEOLOGY, *i-de-ol'-o-je* (Gr. *idea*, idea, and *logos*, discourse), is literally the science of idea[illegible] and is the term employed by the later disciples of Cordillac to designate their system of philosophy. The name was first employed by Destutt de Tracy in his work entitled *Elémens d'Idéologie*.

IDES, *idez* (supposed to be derived from the obsolete Latin verb *iduare*, to divide), the second of the three great divisions of the month in the ancient Roman kalendar. The *calends* were the first days of the month; the *ides*, days near the middle of the month; and the *nones*, the ninth day before the ides commenced. In March, May, July, and October, the ides fell on the 15th of the month, but, during the remaining months of the year, they fell on the 13th. The plan which the Romans pursued was very peculiar. Instead of employing the ordinal numbers first, second, third, and so on, they distinguished the various days of the month by the number which intervened between any given day and the division which next followed the one which was current. For example, as there were always eight days between the nones and the ides, the day after the nones was termed the *eighth before the ides*; the next the *seventh before the ides*; and so on.

IDIOM, *id'-e-om* (from Gr. *idios*, peculiar), a word made use of to express a mode of speaking or writing which is foreign to the usages of grammar or the general law of language, and which is restricted to some individual dialect. For example, a number of words arranged in any peculiar manner may be a Latin idiom; the same transposed and translated, an English or French idiom; and so on. The sense of the word itself is by no means restricted, as the French word *idiome* expresses any peculiar dialect or language, although *idiotisme* may be deemed a more correct equivalent for our own word idiom. There are several subordinate words to express the idioms of different nations; as Latinism for a Latin one, Gallicism for a French idiom, Hibernicism for an Irish one. The French idiom *Revenons à nos moutons* may serve as an illustration of the peculiar meaning of the word, as the literal translation of the phrase is, "Let us return to our sheep," whereas it is understood, in an idiomatic sense, to express, "Let us go back to our subject."

IDIOPATHIC, *id-e-o-path'-ik* (Gr. *idios*, one's own; *pathos*, an affection), a term applied to a disease which is not dependent on any other complaint, and therefore opposed to those diseases called symptomatic.

IDIOSYNCRASY, *id-e-o-sin'-kris'-se* (Gr. *idios*, proper; *sun*, with; *krasis*, temperament), means a peculiar temperament of mind, or of body; a state of constitution peculiarly susceptible to be affected by certain agents, which in general produce no effect upon others. In this way, some persons are violently affected by honey, coffee, butter, &c. What are commonly called antipathies belong to this class. (*See* ANTIPATHY.)

IDIOT. (*See* INSANITY.)

IDLENESS, *i'-dl-ness* (Ang.-Sax.), a word capable of many acceptations, but the general meaning of which expresses abstinence from labour or employment; or, in other words, the state of a person who is unemployed in labour or unoccupied with business. Shakspere has *idleness* to express unimportance and trivialness, while Bacon deems it identical with foolishness and infatuation; as in *idleness of brain*. In the sense of laziness, in which the word is sometimes, in fact often, understood, idleness is but a form of moral degradation, one that debilitates the body in as great a proportion as it incapacitates the mind for healthy labour.

IDOCRASE, *id'-o-krais* (Gr. *idea*, form; *krasis*, mixture), in Min., a variety of the garnet, known also as the Vesuvian or pyramidal garnet. It was originally found in the ejected calcareous matter on Vesuvius, but it also occurs in the primitive rocks. There are two principal varieties,—the purple or violet, known as *hyacinth*, and the green, *chrysolite*.

IDOL, IDOLATRY, *i'-dol*, *i-dol'-a-tre* (Gr. *eidolon*, an image; *latreia*, worship).—The term idol is generally applied to those figures of metal, stone, or wood, used by the pagans to represent their deities; and the term idolatry, to the worship of them. In the Pentateuch and the book of Job,—two of the oldest books we possess, idolatry is spoken of; and it is supposed that the practice was conveyed from Egypt to India in the 17th century before the birth of Christ; and from India, in a modified form, to Northern Europe, about nine centuries later. Idolatry included the worship of all beings in heaven and on earth, visible or invisible, living or dead, and also the images or symbols of these. The worship of the sun, moon, and stars, was probably one of the first forms of idolatrous worship. Rapidly, however, it began to embrace other objects, and even assumed a degrading and repulsive aspect. In Egypt, beetles, bulls, and many other animals, were worshipped, and the idolatry of that time closely resembled the modern form called *Fetichism*. The ancient Greek and Roman idolatry was dignified by all the charms that art and poetry could throw around it; but the most popular Grecian idols were rude, and almost formless images. It is generaly considered that the origin of idolatry was a deification of the unseen, incomprehensible powers of nature. The Roman idolatry was not abolished in 404 A.D., by Honorius, although Constantine had ordered the destruction of all idolatrous temples nearly a hundred years before. Images were neither worshipped nor used in the early Christian churches. The first actual notice of a decree to make an image of Christ is not to be found till the 7th century. Tertullian, and others of the fathers, held that painting and engraving were forbidden by the second commandment:—"Thou shalt not make unto thyself any graven image; thou shalt not bow down to them, nor worship them." Towards the close of the 4th century, pictures of saints and martyrs were admitted into churches. In

the next century, images followed, and a species of Christian symbolism was built up out of pictures and images, which represented the leading points of Christianity visibly. For several centuries afterwards, images of the Virgin, saints, martyrs, &c., were honoured with the same observances as the pagans paid to their idols. Lights were burned before them, incense was burnt, and prayers were offered up to them, hymns were sung to them, and miracles ascribed to them. At the period of the Reformation, however, the Protestant church abolished the worship of images.

IDYLL, or IDYL, *i'-dil* (Gr. *eidullion*, the diminutive of *eidos*, form), a short pastoral poem, or an animated description and representation of ordinary objects of nature in harmonious verse. The bucolic poems of Theocritus are called idyls, while those of Virgil are distinguished by the name of Eclogues, which renders it a difficult matter to decide why there should be any difference in name, as both compositions are of a similar nature throughout. That the ancients did not restrict the use of the word, may be seen by the works of Ausonius, which are called idylls. In English literature, Thomson's "Seasons," Burns's "Cotters' Saturday Night," and Goldsmith's "Deserted Village," are examples of idylls; while Tennyson, in his "Idylls of the King," has even extended the interpretation of the word to a farther degree than was done by the ancients.

IGNATIA, *ig-nai'-she-ă*, in Bot., a gen. of the nat. ord. *Loganiaceæ*. The species *I. amara* has been supposed to yield the seeds known as St. Ignatius's beans, but Bentham believes that these seeds are the produce of a species of *Strychnos* (which *see*). They come to us from the Philippine islands. They are intensely bitter, and contain the alkaloid strychnia in even larger proportions than the nux vomica seeds.

IGNEOUS ROCKS, *ig'-ne-us* (Lat. *ignis*, fire).—The term igneous is applied in Geology to all agencies, operations, and results, which seem connected with, or to have arisen from, subterranean heat; and igneous rocks include the Volcanic, Trappean, and Granitic series, all of which are evidently the products of fusion, either in the interior or at the surface of the crust; geologists, consequently, use the term igneous as synonymous with Plutonic, pyrogenous, unstratified, and other similar terms.

IGNIS FATUUS, *ig'-nis făt'-u-us* (Lat., literally 'the foolish fire'), a term applied in Nat. Phil. to a sort of luminous meteor which flits about in the air a little above the level of the ground, and which appears generally in marshy places, in churchyards, and near stagnant waters, during the nights in summer. It is called in different country places in England, by the names of "Jack o' Lantern," or "Will o' the Wisp;" the people ascribing its appearance to the agency of evil spirits. It is, however, produced by the phosphorus evolved from decayed leaves, and other vegetable and animal matter in a state of decomposition.

IGNITION. (*See* INCANDESCENCE.)

IGNORAMUS, *ig-no-rai'-mus*, in Law, the term used by the grand jury when they throw out or ignore a bill of indictment. It is a Latin word, signifying 'we are ignorant of the matter,' or 'we have not sufficient evidence on the subject.'

IGUANA, *ig-u-ăn'-nă*, the type of the *Iguanidæ*, a fam. of Saurian reptiles, forming, along with the *Agamidæ*, the tribe *Strobilosaura*. With regard to the name of this family, Cuvier states, on the authority of Hernandes and Scaliger, that it was originally a St. Domingo word, where it was pronounced by the natives *hiuana*, or *igoana*. He next affirms that it was derived, according to Bontius, from the Javanese *leguan*. If so, the word must have been transported to America by the Portuguese or Spaniards, and there applied to the reptile. However, whatever the definition, the word itself has been Latinized, and is used to distinguish the class to which it is applied. The principal characteristics of the *iguana* are as follows:—A large thin fold of skin, or dewlap, under the chin; cephalic cuticular plates, polygonal, unequal in diameter, flat, or carinated; a double row of small palatal teeth; maxillary teeth with their edges finely denticulated; a crest on the back and tail; toes long and unequal; tail very long, slender, and compressed, and covered with small, equal, imbricated, carinated scales. It is a very nimble reptile generally, and lives in warm climates. Some of the species live upon vegetables, and others upon animal food. It particularly inhabits South America and the West Indies, where it is very numerous. From its cleanly habits and delicate flesh, it is esteemed a great dainty, and tastes very like chicken. It lives for the most part on trees; but when forced to take the water, it can swim very readily. This variety of the *Iguanidæ*—*i.e.* the common iguana, or *Iguana tuberculata*—is about five feet in length, although many exceed that. It is of a more or less green colour throughout, and its dewlap is of a bright yellow colour, as is also the crest which runs along the back. They are thought to be best fit for eating in the spring, when they are sought and hunted with great avidity. Although in reality very timid animals, they have a very formidable appearance, which is utterly denied by their harmless habits and endeavours always to escape when pursued. The female deposits her eggs in the sand, where they are hatched by the warmth of the sun.

IGUANODON, *ig-u-ăn'-o-don* (*iguana*, and Gr. *odous*, a tooth), an extinct gen. of gigantic reptiles, discovered by Dr. Mantell, and named by him on account of the resemblance of their teeth to those of the iguana. Soon after the discovery by Dr. Mantell of the bones of colossal reptiles in Tilgate Forest, his curiosity was excited by some teeth of a very peculiar character, since they were totally unlike any that had previously come under his observation. The first specimen that attracted his attention was a large tooth, which, from the worn, smooth, and oblique surface of the crown, had evidently belonged to an herbivorous animal, and so entirely resembled the corresponding part of an incisor of a large pachyderm ground down by use, that he was much embarrassed at finding it in such ancient strata. As no existing reptiles are capable of masticating their food, he could not venture to assign the tooth to a saurian. For some time the nature of the animal to which the tooth had belonged remained in doubt. Baron Cuvier, to whom the tooth was shown, pronounced it to be an upper incisor of a rhinoceros; while, in the Geological Society of London it was said that the teeth were of no particular interest, and either belonged to some large fish allied to the *Anarrhicas lupus*, or wolf-fish, or were mammalian teeth from some diluvial deposit. Dr. Mantell and Dr. Wollaston alone contended that they were the teeth of some unknown herbivorous reptile. It was not, however, till afterwards, when other bones had been discovered, and these compared with the skeleton of an iguana, that the correctness of their opinions was admitted. The size to which these reptiles attained in former ages must have been enormous. There is a portion of a femur in Dr. Mantell's collection twenty-two inches in girth at the smallest part. It is therefore calculated that the thigh-bone of the iguanodon exceeded in bulk that of the largest elephant, and its length is estimated to have been from four to five feet. After comparing the bones of the iguanodon with those of the iguana, and taking an average from eight separate parts of the respective skeletons, Dr. Mantell gives the following as the dimensions of this giant of the Weald.—Length from snout to extremity of tail, 70 feet; length of tail, 52½ feet; circumference of body, 14½ feet. On the snout of the iguanodon was a horn; and the general appearance of the reptile must have fully realized the wildest ideas of the dragons of poetic lore. Professor Owen does not think that the iguanodon was so large an animal as Dr. Mantell infers, but believes that it was about thirty feet in length. It appears probable that the most formidable instrument of attack and defence possessed by this reptile was its long and powerful tail. During the age of Reptiles, the iguanodon seems to have occupied the same relative station in the scale of being, and fulfilled the same general purposes in nature's economy, as the mastodons, mylodons, and mammoths of the tertiary era, and the pachydermous animals of the present time.—*Ref.* Mantell's *Petrifactions and their Teachings*; Owen's *Report on British Fossil Reptiles*.

I.H.S., an abbreviation of the Latin phrase *Jesus hominum salvator* (Jesus the Saviour of mankind).

ILEUM, *il'-e-um* (Gr. *eileo*, I turn about, from its numerous convolutions), in Anat., is the name given

to the last portion of the small intestines, which terminates at the valve of the cæcum.

ILEUS, or ILIAC PASSION, *il'-e-us, il'-e-ăk* (Lat. *iliaca passio*), in Med., is a severe intestinal disease, characterized by violent griping pain, accompanied with retraction and spasms of the abdominal muscles, costiveness, and vomiting of fæcal matter. It arises from many causes, and is generally symptomatic of some other disease. Among the most frequent causes of this disease, are strangulated hernia, intus-susception, or the retention of one part of the bowel within another, unnatural adhesions between adjacent folds of the intestines, inflammation, &c. The medical treatment consists in removing the exciting cause. If there is evidence of an inflammatory state, blood should be freely abstracted from the arm, and leeches applie to the abdomen. For the rest, carminative aperients, fomentations, and glysters are to be used. Dry and humid fomentations, warm baths, and warm and copious glysters, afford the most reasonable chance of success.

ILEX, *i'-leks*, in Bot., the Holly, a gen. of the nat. ord. *Aquifoliaceæ*. The species *I. Aquifolium* is one of [illegible] t beautiful shrubs or low trees, displaying either character, according to situation, age, and application of art. It is found in most parts of Europe, and in North America, Japan, and Cochin-China. In Britain it is found in natural woods and forests, sometimes forming extensive assemblages of fine trees. Some of the noblest specimens are in Medwood Forest, Staffordshire, and in the woods of Dumbartonshire. By culture, more than a hundred varieties and subvarieties have been developed, differing in the variegation, margin, and size of the leaves, and in the colour of the fruit. The common green prickly-leaved holly makes the best of all hedges, whether we regard its qualities for defence, shelter, duration, or beauty. It is, however, very slow of growth, unless most carefully cultivated; and, for this reason, hawthorn is generally preferred as a hedge-plant. The custom of dividing gardens by trimly-shorn hedges of holly was very general about the end of the 17th century. Evelyn's impenetrable holly hedge at Deptford has been much celebrated: it was 400 feet long, 9 feet high, nd 5 feet broad The deep shining green leaves and beautiful coral berries of the holly are essential elements in the domestic decorations with which Father Christmas honoured Not merely as an ornamental evergreen is the holly noticeable. Its white wood is extremely hard, and is used by cabinet-makers for inlaying, and to some extent by engravers. From its inner bark birdlime is prepared. The leaves have been employed in intermittent fevers The berries are purgative and emetic. The North-American species, *I. vomitoria*, has bitter leaves, of which the Creek Indians make a decoction which they use as an emetic, unde the name of *black drink*. The leaves and young twigs of *I. paraguayensis*, the Brazilian or Paraguay holly, are extensively employed in South America as tea, under the name of *maté* or *Paraguay tea*. It is remarkable that *maté* contains *caffeine*, the principle existing in coffee and Chinese tea It has somewhat similar properties to those of Chinese tea; but it is more exciting, and, when taken to excess, produces a kind of intoxication. Another *maté*, called *gongonha*, is prepared in Brazil from the species *I. gongonha* and *theezans*. Johnston has estimated the consumption of *maté* at 20,000,000 lbs. annually. The fresh leaves of the South-American hollies have great astringency, and on this account they are much used by the dyers of Brazil.

ILIAD and ODYSSEY, *il'-e-ăd od'-is-se* (Gr. *ilias* and *odusseus*, Ulysses), two great works, as it is supposed, from the hand of Homer, the greatest and most ancient of the poets of Greece. The Iliad is the first epic poem in existence, and its subject is the siege of Ilium, or Troy, or, more properly speaking, the quarrel between Achilles and Agamemnon, the general of the Grecian army before that city. It consists of twenty-four books, the first of which relates the origin of the quarrel, and the residue contain an account of the efforts made by Agamemnon and his chiefs to conquer the Trojans without the co-operation of Achilles, the defeat of the Greeks, the pacification of Achilles, and his resumption of arms in favour of the sons of Hellas, and the death of Hector (the Trojan champion) by his hand. The Odyssey, on the other hand, merely contains the wanderings of Ulysses, and his return to his native land, Ithaca. There have been many arguments within the present century, on Homer and his works, and many doubts have been disseminated as to whether Homer really *did* write the Iliad and Odyssey; these doubts having been founded on the fact that the art of writing was unknown to the Greeks in the time of Homer. The "Wolfian theory," as it is termed, declares that the Iliad and Odyssey are but fragments of ballads, collected from different sources, and afterwards strung together, and handed down to us in a complete form by Pisistratus. A writer in the "Encyclopædia Britannica" thus observes on the subject:—"In an investigation of this kind, the presumptions with which a man starts, though not always distinctly set forth, are of the utmost consequence in determining his procedure. The false historical presumptions from which Wolf proceeded naturally led him to seek for flaws in the texture of the Homeric poems; and it is manifest that even Mr. Grote, who justly considers the extreme Wolfian theory as quite untenable, in propounding his wild scheme of resolving the Iliad into two distinct parts, has been influenced, partly by his desire to mitigate what he calls 'the wonder' of the creation, and the preservation of two such long continuous poems, bearing the stamp of one mind, in an age when writi was altogether unknown. That there are no external historical presumptions of this kind, there is every evidence to prove; but a presumption of another kind must now be stated. It is not to be surmised that Homer would be anxiously accurate about the mere articulation, or joint-work of his epic poems, for many reasons. In the first place, because he was a poet, and aimed, as all true poets do, mainly at producing an effect on the feelings and imaginations of his hearers, not on the mere cognitive capacity. Small mistakes in incidental matters, taken cognizance of by the curious understanding only, might, without offence, be committed by a great singer of poetry, as they would certainly not be observed by a healthy-minded hearer; and that mistakes of this kind actually have been made, and are made even daily at the present time, the literature of the day bears ample testimony. In the second place, Homer was a popular poet, or, to use poetical language, 'a wandering minstrel, with a lyre in his hand, as he is truly represented in ancient biographies,' and 'not a learned Southey, sitting in a library, with books, and desk, and pen and ink, printers' proof-sheets, publishers' quarterly reviews, and every sort of literary apparatus of the newest and most approved description.' Therefore, in judging the Iliad as a whole, it must never be forgotten, although such seems generally to be the case, that it was not Homer's immediate object to compose a great whole, as he had neither reason nor opportunity for doing so. His art, therefore, was to concatenate a series of parts, which, while they might be used with effect on a few great festive occasions as a whole, were meant to produce their general and most appreciable effect in the shape of parts, either absolutely complete in themselves, or admitting of being easily supplemented by the indwelling traditional lore which the poet could legitimately presuppose in the minds of his hearers. Something analogous to this we have in the great historical plays of Shakspere, consisting of several parts, in any of which, if there happened to be some small inconsistencies with the other parts, none but a curious person, making a business of criticism, would ever notice it, as the parts, though connected in conception, are so constructed as to give the impression of completeness when they are represented as separate wholes. If this point be duly considered,—and there is nothing more certain, or more duly attested in the history of these poems, the weakness of a great number of the objections made by Lachmann and Grote to the concatenation of the Iliad will instantly appear. The tenth book, for instance—that in which the midnight expedition of Diomedes and Ulysses is described—has, it is said, no necessary connection with the parts of the poem that precede or follow, and might be cut out without injury. Of course; because it was the object of the poet so to string together a number of little wholes, originally independent, that they might still remain little wholes, and yet become parts of a great whole,—an exquisite

trick of art plainly, and which, as the whole history of popular poetry teaches, it required a mighty genius like Homer to perform." From these remarks it must not be for a moment supposed that there are no interpolations in the original text of the author, as there can be no doubt that additions have been made, as well as parts subtracted from the poem originally conceived by the blind poet. From the Iliad, it is not a very wide step to proceed to the Odyssey; and here another question arises, whether if, considering the Iliad to be the entire production of Homer, we cannot grant that there are reasonable grounds for supposing the Odyssey to proceed from the plastic powers of a different and inferior minstrel. There is a certain milder tone and current of song in the last poem which might well hold out the inference that the Iliad did not emanate from the same conceptive faculties. The great mistake, however, is that of the German school, in not placing any weight whatever on the Hellenic attribution of both poems to Homer. The writer in the "Britannica" proceeds:—"On this point, we differ *toto cœlo* from the Germans, and are nothing ashamed to believe, with our learned countryman Colonel Mure, that Aristotle, Plato, and the overwhelming majority of the highest intellects in Greece, had very sufficient reasons for placing a wide gulf between the two epic poems which they agreed to stamp with the name of Homer, and the very inferior works of a cognate nature, known afterwards under the name of the *Epic Cycle*. Nature did not produce twin Homers in those old Greek days, we may depend on it, any more than she has produced in these days twin Dantes or twin Shakesperes. If there had been a second Homer, of genius large enough to produce a counterpoise to such a work as the Iliad, no doubt the *Homeridæ* of some second Chios would have been equally eager to stereotype his memory in their composition, and to immortalize themselves with his name. But precisely, we imagine, because the only one Homer, was there only one guild of Homeridæ, and one uniform, undisputed authorship of the Iliad and Odyssey among the Greeks, till som pragmatic grammarians [illegible] whom a certain Xenon [illegible] the prototypes of our modern Wolfians, began to nibble at imagined incongruities, and to moot the question of separate authorship. Such being the historical conditions under which the question is raised, it is manifest that the presumptions, as in the question about the unity of the Iliad, are all against the disintegrators; and a detailed examination of their array of minute and microscopic objection to the common authorship will, in all likelihood, bring the intelligent student to a verdict of *not proven*." So much for the arguments for and against the authorship of the Iliad and Odyssey. The great excellence of Homer's poetry lies in its extreme affection for nature, and the simple and healthy qualities with which it is endowed. Not the less admirable are the vigorous and luxuriant changes which we ever and anon come across, all of which show, what is well termed "the billowy enthusiasm" of the blind old poet. Mr. Newman, in his pamphlet on *Homeric Translation*, observes, with regard to the quaint style which we find so abundant through the Iliad and Odyssey,—"It is quaint to say, 'Patroclus kindled a great fire, *godlike man!*' or, 'Automedon held up the meat, *divine* Achilles sliced it,' quaint to address a young friend as 'Oh pippin!' or 'Oh soft-heart!' or 'Oh pet!' whichever is the true translation. It is quaint to compare Ajax to an ass whom boys are belabouring, Ulysses to a pet ram, Agamemnon in two lines to three gods, and in the third line to a bull; the Myrmidons to wasps, Achilles to a grampus chasing little fishes, Antilochus to a wolf which kills a dog and runs away, Menelaus striding over Patroclus's body to a heifer defending her first-born. It is quaint to say that Menelaus was as brave as a blood-sucking fly, that Agamemnon's sobs came thick as flashes of lightning, and that the Trojan mares, while running, groaned like overflowing rivers. All such similes came from a mind quick to discern similarities, but very dull to feel incongruities; unaware, therefore, that it is on a verge where the sublime easily turns into the ludicrous,—a mind and heart inevitably quaint to the very core." Such may be considered to be a brief description of the style in which the Iliad and Odyssey are written; in other respects these poems come under the general characteristics of *epic poetry*, upon which some remarks will be found given under the article bearing the same appellation. Homer has been translated into nearly every language, and his fame may well be said to be world-wide. The best Italian translations are by Cesarotti and Monti; French, by Dacier, De Rochfort, Bitaubé, and Dugas-Montbel; German, by Stolberg and Voss; English, by Chapman, Hobbs, Pope, Cowper, Sotheby, Newman, Gladstone, Herschel (in part), Arnold, and Wortley. The best editions of the original work, according to the *Encyclopædia Britannica*, are that of Florence, 1488, *curâ Demetrii Chalcondylæ*; the *Editio Princeps*, in two vols. folio, of which there are only about sixty copies extant,—Hague, 1802; Bekker, Berlin, 1843; Baumlein, Leipsic, 1854. The English editions are too numerous to mention.

ILLECEBRACEÆ, *il-les-e-bra'-se-e* (from Lat. *illicio*, I entice or induce; from its power to vesicate, when applied to the skin in cataplasms), in Bot., a synonym for Paronychiaceæ (which *see*).

ILLICIUM, *il-lish'-e-um* (Lat. *illicio*, I allure, from having a most agreeable perfume), in Bot., a gen. of plants remarkable for the fragrance and beauty of their flowers and foliage, belonging to the nat. ord. *Magnoliaceæ*. The species *I. anisatum*, or star-anise, has the odour and flavour of aniseed. They have all laurel like leaves. The fruit is used by the Chinese as an aromatic and carminative, and as a spice. The oil obtained from the seeds is said to be substituted occasionally for oil of anise.

ILLUMINATI, *il'-lu-min-ai'-ti* (Lat., the enlightened), a name applied to the members of a secret society, founded in 1776, by Adam Weishaupt, professor of canon law at Ingolstadt. The professed object of the society was, by one single tie, to unite men of all [illegible], in spite of different opinions, religions, and ranks, to instruct all classes; and to surround monarchs with men of integrity, justice, truth, and courage. From the ablest of his law-students, Weishaupt selected apostles for his new scheme. These apostles he called *Areopagists*, and sent to various parts of Europe to work out his new system. Lodges, numbering 1,000 disciples, were established in Bavaria, Suabia, Franconia, Milan, and Holland, before the existence of the society was known at Ingolstadt. The society itself formed a hierarchy consisting of eight grades, exclusive of minor subdivisions; namely, the Novice, the Minerval, the *Illuminatus minor*, the *Illuminatus major*, the Scottish Cavalier, the Priest, the Regent, and the King. Young men were preferred, and Lutherans were taken rather than Catholics. The Baron [illegible] Knigge, and Bode the philosopher, zealously promoted the views of the society, which contained, in its most flourishing condition, 2,000 members. A dispute at length arose between Weishaupt and Knigge, when the latter was deposed, retired to Brême, and wrote against the Illuminati. In 1785 the whole society was dissolved by order of the Bavarian government. The papers and documents of the leaders were seized in the following year, and Weishaupt fled to Halle, where he died. A new combination, the founder of which was Dr. Bahrdt, was soon afterwards formed, under the name of the Germanic Union. Although it is doubtful whether this second society ever attained to a perfect organization, it is generally believed that its political intrigues favoured and hastened on the French revolution.

ILLUMINATING, *il-lu'-min-ai-ting* (Lat. *lumen*, light; Fr. *illuminer*, to enlighten), the art of embellishing and adorning manuscripts with pictorial illustrations of various scenes and events, portraits, initial letters, borders, &c., which was practised in the mediæval ages prior to the introduction of printing. Illuminating was generally executed by the monks, almost every monastery having a *scriptorium*, or writing-room, in which copies of the Scriptures and other works were made with great labour, neatness, and care, and afterwards ornamented with pictures and devices in gold and colours. The colours employed by the artists were extremely brilliant, and the general effect was heightened by the introduction of gold and silver leaf, which

was highly burnished. The initial letters and ornamental borders are generally very elaborate, and executed with great skill and taste; and although the figures are for the most part stiff and formal, the expression of various passions is frequently conveyed with great force and correctness; and the portraits of eminent persons, particularly those which were executed between the 5th and 10th centuries, are often extremely good. The illuminations that were executed in the 11th, 12th, and 13th centuries are not so carefully drawn and coloured, nor do they evince so much artistic skill as those of an earlier period; but from the commencement of the 14th century to the introduction of printing, they show considerable improvement in style and execution. The figures in the Bayeux tapestry (*see* BAYEUX TAPESTRY) may be taken as a fair specimen of the manner in which the human form and other objects were rendered by mediæval artists. The illuminators, and the art itself, were said by Felton to borrow their titles "from the illumination which a bright genius giveth to his work." Illumination was practised by the Romans, as Pliny mentions in his "Natural History," book xxv. chap. 2, a biographical work, written by Varro, which included the lives of 700 Romans of eminence, and was enriched with portraits executed by the author himself. Illuminated works are of great value to the archæologist and historian, as they show the manners, customs, and habits of the ancients, and the various nations of Europe, to the close of the 15th century, in matters ecclesiastical, military, and civil, and they afford illustrations of the various [illegible], utensils, armour, and weapons, that were [illegible], as well as the prevailing style of architecture of the period. They are also of the greatest use in illustrating and explaining many important points which relate to the history of the times in which they were respectively drawn. Many valuable specimens of illuminated manuscripts are preserved in all the principal libraries of Europe, and copies of a great number of drawings illustrative of English antiquities, including portraits of the early kings and queens of England, with representations of the persons and costume of our ancestors, their arms, houses, ships, and household furniture, have been published by Mr Strutt, an eminent English antiquary. Since the revival of Gothic architecture, and the introduction of mediæval ornamentation into our churches, the illumination of scrolls with texts of Scripture, for decorative purposes in connection with churches, schools, &c., and a variety of ornamental work, has become a fashionable amusement, and affords easy and [illegible] to many who practise it. Hand-[illegible] in the art, which is similar in its style and method of execution to heraldic painting and painting in body-colours, with boxes of colours and liquid gold and silver, prepared for the purpose, may be obtained from any bookseller or artists' colourman. —*Ref.* Strutt's *Regal and Ecclesiastical Antiquities of England;* Strutt's *View of the Customs, &c., of England,* Owen Jones's *Grammar of Ornament.*

ILLUMINATION, *il-lu'-min-ai'-shun,* the act of illuminating or making luminous. Through the invention of coal gas, the operation of supplying light to the streets and interiors of houses has advanced greatly within late years. The employment of gas for illuminating purposes can be traced back to remote antiquity; yet the substantial history of its application can be given in a few lines. Issues of inflammable gas have been observed at various times in different parts of the world. Amongst these may be reckoned the holy fires at Baku, on the Caspian Sea, and those of Pietra Mala, in Italy. Such issues were, however, only looked upon with suspicious dread by the ignorant people who observed them. If we could believe the accounts of the Chinese, which we cannot safely do, it would appear that many years ago they applied natural inflammable gases both to purposes of heating and illumination. In the coal districts of this country, large sources of inflammable gas exist in the coal-mines; and in some localities, such as Chat Moss, in Lancashire, so easily is this gas procured, that it is only necessary to plunge an iron rod a few yards deep into the soft peat, and then, on its withdrawal, to insert a tin tube, when a copious discharge of gas is evolved at a high pressure, and apparently for an unlimited period of time. As early as 1659, Mr. Thomas Shirley communicated to the Royal Society a paper describing some experiments on an inflammable gas issuing from a well near Wigan, in Lancashire; and nearly a century later, the Rev. John Clayton discovered that an inflammable gas could be obtained from coal when exposed to heat in close vessels. Gas thus artificially produced was not practically used till 1792, when Mr. William Murdoch lighted his office and house at Redruth, in Cornwall, with it; and since that time this branch of the chemical arts has progressed rapidly and satisfactorily. (*See* GAS MANUFACTURE.) In all cases of artificial illumination, it is of great importance that we should be able to determine with facility the relative value of the light obtained. This is generally effected by comparing the illuminating sources employed with some standard source of light. After a number of experiments to fix upon a standard, Dr. Ure says,—"After comparing lights of many kinds, I find every reason to conclude that a large wax candle, of three to the pound, either long or short—that is, either 12 or 15 inches in length, as manufactured by one of the great wax-chandlers of London, and furnished with a wick containing 27 or 28 threads of the best Turkey cotton, is capable of furnishing a most uniform or nearly invariable standard of illumination. It affords one-tenth of the light emitted by the Argand lamps of the Trinity House, and one-eleventh of the light of my mechanical lamp, when each lamp is made to burn with its maximum flame, short of smoking." For many of his determinations, however, Dr. Ure used the French mechanical lamp, known as Carcel's lamp. The following table contains Péclet's estimation of the illuminating powers of various candles, and their consumption of material in the hour; the light given out by a Carcel Argand lamp, consuming 651 grains in an hour, being called 100.—

	Intensity of light.	*Consumption per hour.*
Tallow candles, 6 in lb. ..	10 66	8·51
Stearine, or pressed tallow, 8 in lb.	5 74	7·51
Ditto, 5 in lb.	7 50	7·12
Wax candles, 5 in lb. ...	13 61	8·71
Spermaceti, 5 in lb. ...	14 10	8 92
Stearic acid, commonly called stearine, 5 in lb. .	14 10	9·33

The term Photometry is applied to the numerical estimation of the degrees of the intensity of light. "If," says Sir John Herschel, "light be a material emanation, a something scattered in minute particles in all directions, it is obvious that the same quantity which is diffused over the surface of a sphere concentric with the luminous point, if it continue its course, will successively be diffused over larger and larger concentric spherical surfaces, and [illegible], or the number of rays which fall on a given space in each, will be inversely as the whole surfaces over which it is diffused; that is, as their radii, or of their distances from the source of light.. . Let a candle be placed behind an opaque screen full of small equal and similar holes; the light will shine through these, and be intercepted in all other parts, forming a pyramidal bundle of rays having the candle in the common vortex. If a sheet of white paper be placed behind this, it will be seen dotted over with small luminous specks, disposed exactly as the holes in the screen. Suppose the holes so small, their number so great, and the eye so distant from the paper that it cannot distinguish the individual specks, it will still receive a general impression of brightness; the paper will appear illuminated, and present a mottled appearance, which, however, will grow more uniform as the holes are smaller and closer and the eye more distant; and if extremely so, the paper will appear uniformly bright. Now, if every alternate hole be stopped, the paper will manifestly receive only half the light, and will therefore be only half as much illuminated; and, *cæteris paribus,* the degree of illumination is proportional to the number of holes in the screen, or to the number of equally illuminated specks on the surface; *i. e.,* if the speck be infinitely diminished in size and infinitely increased in number, to the number of rays which fall on it from the original source of light." Reasoning in this man-

ner, Sir John Herschel establishes the following definitions:—1. The real intrinsic brightness of a luminous object is the intensity of the light of each physical point in its surface. 2. The apparent intrinsic brightness of any object, or luminary, is the degree of illumination of its image, or picture, at the bottom of the eye. 3. The absolute light of a luminary is the sum of the areas of its elementary portions, each multiplied by its own intrinsic brightness. 4. The apparent light of an object is the total quantity of light which enters our eyes from it, however distributed in the retina. Instruments made for the purpose of measuring the illuminating power of any body are called Photometers. They are of various forms. Wheatstone's photometer is one of the best known It is a small sphere, with a reflecting surface. Being placed between the two lights, each light is seen reflected on it by the spectator. By an ingenious contrivance, a rapid rotary motion is given to the sphere; and by the principle of the persistence of impressions, the spectator sees two curves of different brightness. The brighter light is then removed till the brightness of the curves seems equal, and the intensities of the luminous points are then as the squares of the distances. The illuminating power of gas is often greatly dependent upon the burner employed. The chief burners now employed are the bat's-wing, fish-tail, Argand, Bude Argand, &c. The bat's wing consists of a fine slit cut into an iron nipple, [illegible] a flat fan-like flame. The fish-tail consists of [illegible], perforated by two holes, drilled so that th[illegible] gas are inclined to each other at an angle of about 60°. A flat film of flame is thus produced resembling somewhat the tail of a fish. (For the form of the Argand burner, *see* ARGAND LAMP; and for other methods of illumination, *see* CANDLE MANUFACTURE, LAMP.) One of the most brilliant methods of illumination discovered in late years, is that of the electric light. It is produced by the current of a powerful voltaic battery between two pencils of hard charcoal, such as that deposited in the retorts of gas-works. Charcoal being an [illegible] conductor, becomes incandescent, and as [illegible] fusible at any known temperature, the splendour of the light is only limited by the power of the battery. After being formed into pointed cylinders, the charcoal is mounted in metallic holders connected with the ends of the voltaic battery, and the pencils are so fixed that their points can be brought into contact, or made to recede from each other, as required. When in contact, the current passes through them, and the charcoal becomes brilliantly luminous. When separated, a splendid flame passes between them. The electric light can be produced in an exhausted receiver, under water, or in gases which do not support combustion. M. Foucault has applied this light, with great effect, as a substitute for the lime light in the gas microscope. It has also been employed, both in France and England, on some occasions, to give light to workmen who were obliged to continue operations at night. The electric light has also been used on the theatrical stage, in order to produce [illegible] effects; and in illuminations of cities, as [illegible] of joy, this light is often used to render [illegible].

ILLUSTRATION, *il-lus-trai'-shun* [illegible] to show), a term used in Rhet[illegible] comparison, or simile, in this fact only, that illustration is used to illumine an argument, while the former are only used to give force to expression. *Illustration* is sometimes used in a wider and far more extended sense, in which, according to Brande, it seems to comprehend example, in which case it is the recital of a particular fact or instance, evincing the truth of a general proposition laid down in argument.

IMAGE, *im'-ej* (Lat. *imago*), in Rhet., a term applied to denote a metaphor which has been dilated and made into a complete word,—painting by an assemblage of different ideas moving through it, but which is not sufficiently expanded to be allegory.

IMAGE, in Optics, is the spectrum, or appearance of an object made by reflexion or refraction. "The brightness of an image depends evidently on the quantity of light concentrated in each point. Setting [illegible] the effects of aberration, the brightness must [illegible] be proportional to the apparent magnitude (as seen from the object) of the mirror or lens by which the rays are reflected or refracted, multiplied by the area of the object, and divided by the area of the image. But the apparent magnitude of the lens, as seen from the object, is proportional to the square of the diameter of the lens divided by the square of the distance of the object; and the area of the object divided by the area of the image is equal to the square of the distance of the object divided by the square of the distance of the image from the lens; therefore the brightness of the image is proportional to the square of the diameter of the lens divided by the square of the distance of the image from the lens; that is to say, the brightness, or degree of illumination, of the image depends only on the apparent magnitude of the lens, as seen from the image, and not in any way on the distance of the object." For this reason certain stars are rendered visible by the aid of large telescopes, and are perfectly invisible when a smaller one is used.

IMAGE-WORSHIP AND -BREAKING. (*See* IDOL, IDOLATRY.)

IMAGERY.—A general term applied to allegories, metaphors, similes, and such-like figures, used in rhetoric (which *see*).

IMAGINARY QUANTITIES, *im-aj'-e-nă-re*, a term applied in Algebra to the even roots of negative quantities, or the imaginary results of [illegible] operation. By infinite series, and [illegible] fractions, it can be easily proved that—

where, if $x = \pm\dot{0}$, we shall have $\sqrt{-1} = \pm 0 \mp \frac{1}{0}$ &c., to which no definite arithmetical meaning can possibly be attached; and, consequently, $\sqrt{-1}$ cannot be assigned, and not even an approximation can be made to its value. This circumstance shows that though $\pm\sqrt{-1}$ may have arisen from the generalizations of symbolical algebra, the origin and meaning must be [illegible] in other quantities than numbers; for in [illegible], considered without reference to its *application*, every *inverse* operation implies the previous [illegible] of the corresponding *direct* operation; and therefore *surd* quantities, whereof the arithmetical values can never be *exactly* ascertained, have their origin in the application of arithmetic to geometry. [illegible] imaginary quantities have no real value, [illegible] important aid in the higher parts of mathematical analysis, as they indicate a marked distinction between quantities which have no natural or necessary dependence on each other.

IMAGINATION, *im-aj-in-ai'-shun* (Lat. *imago*, an image), in Phil., is a term used in various significations. According to Dr. Reid, imagination, in its proper sense, signifies a lively conception of objects of sight, being distinguished from conception as a part from a whole, and [illegible] says that "the pleasures of imagination are such as arise from visible objects, since it is the sense of sight that furnishes the imagination with its ideas." Others, however, employ the word in a much wider signification [illegible] faculty of the human mind by which [illegible] ideas are produced at will. Philosophers have divided imagination into two,—the reproductive and the productive. By the former, they mean imagination considered as simply re-exhibiting or representing the objects presented by perception, that is, exhibiting them without addition or retrenchment, or any change in the relations which they reciprocally held when first made known to us through sense. The productive or creative imagination is that which is usually signified by the term imagination or fancy in ordinary language. According to Sir W. Hamilton, "imagination, in the common acceptation of the term, is not a simple, but a compound faculty, a faculty, however, in which representation—the vivid exhibition of an object—forms the principal constituent. The reproductive imagination is not a simple faculty: it comprises two processes; first, an act of representation, [illegible], an act of representation [illegible] constituent that the faculty obtains the only title it

can exhibit to an independent existence." In like manner, "the imagination of common language—the productive imagination of philosophers—is nothing but the representative process *plus* the process; to which I would give the name of the comparative." The imagination represents ideas in three principal orders: (1) the natural order, that in which we receive the impression of external objects, or the order according to which our thoughts spontaneously group themselves; (2) the logical order, presenting what is universal prior to what is contained under it as particular, or presenting the particular first, and then ascending to the universal which they constitute; (3) the poetical, which consists in seizing individual circumstances, and grouping them in such a manner that the imagination shall represent them so as they might be offered by the sense. There are different kinds of imagination, as there are different kinds of intellectual activity. There is the imagination of abstraction, the imagination of wit, the imagination of judgment, the imagination of reason, the imagination of feeling, the imagination of the passions.

IMBROGLIO, *im-brole'-yo* (Ital. *broglare*, to confound or mix together), a term applied in Lit. to the plot of a romance or drama, when it is much perplexed, complicated, and interwoven. The Italians themselves also term small burlesques, when rendered ludicrous by similar absurdity, by the same title.

IMIDES, *i'-midez*, in Chem., a class of bodies intermediate between the amides and nitrites, supposed to contain a hypothetical radicle, imidogen, or ammonia less two equivalents of hydrogen. Though not numerous, several of them are well known.

IMMACULATE CONCEPTION, *im-măk'-u-lait kon-sep'-shun* (Lat. *immaculatus*, spotless, pure; *conceptio*, the act of conceiving), of the Holy Virgin, a festival observed in the Roman Catholic church on the 8th December, in honour of the alleged conception of the Virgin Mary without sin. This doctrine was first promulgated about the middle of the 12th century. The devotion to the Blessed Virgin had reached such a height, that many obscure theologians set on foot the idea, that not only was she sanctified from her birth, but also that she was conceived without sin. For a long time there were many disputes as to its acceptation; and it was not defined as an article of faith until the 8th December, 1854, when Pope Pius IX. declared it in the following words:—"We define the doctrine which holds the most blessed Virgin Mary, in the first instant of her conception, to have been preserved free from all stain of original sin, &c. &c." From the ample testimony offered by the Scriptures, however, there is full proof that no one except our Saviour was born thoroughly free from sin; and, consequently, the whole doctrine of the Immaculate Conception rests but on a very slender basis.

IMMATERIALISM. (*See* MATERIALISM.)

IMMERSION, *im-mer'-shun* (Lat., from *in*, into, and *mersus*, part. of *mergere*, to plunge), in Astron., the disappearance of one heavenly body behind another, or within the shadow cast by [illegible] Immersion, or incidence [illegible] soon as the disc of the body that is eclipsed begins to pass behind the disc or shadow of the other.

IMMERSION, BAPTISM BY. (*See* BAPTISM.)

IMMOLATION, *im-mo-lāi'-shun* (from Lat. *immolare*, to sacrifice), a ceremony used amongst the Romans with regard to their sacrifices. It consisted in throwing frankincense, wine, and a species of cake, on the head of the victim, before it was sacrificed; consequently, when *immolation* was performed, the victim was already doomed, and the term became applied to the sacrifice itself.

IMMORTALITY, *im-mor-tăl'-e-te* (Lat. *immortalis*), that quality of perpetual existence which differs only from eternal in the one respect, that the former has a beginning, which does not belong to the latter. Eternity is the attribute of the Deity himself, while immortality only applies to some of his creations; as the soul, for example. The dogma which insists on the immortality of the soul is very ancient, and is connected with almost all religions, although, of course, under a variety of conceptions. Some philosophers have pretended to prove the immortality of the soul from its immateriality; but the idea cannot be carried out, as, after the destruction of the body, the soul might be in a state of coma, or swoon, and thus would be, as it were, annihilated also. Consequently, the hope of immortality must be considered a religious conviction, and not an argument which can be proved by any common-place similes of every-day life.

IMPACT, *im'-păkt* (from Lat. *impingo*, I impinge), in Mech., the single instantaneous blow or stroke communicated from one body in motion, to another body, which may be either in motion or at rest. If the body moves in the direction of the stroke, the impact is said to be direct; if in a different direction, it is said to be oblique. The theory of direct impact, or collision, is as follows:—Let the masses of two balls, or material particles, be m and m', and let them move with uniform velocities, v and v', in the same direction along a straight line; v being greater than v', so that m overtakes m'. Let u be the common velocity of the two balls when the compression at the moment of impact is at a maximum degree; also let P be the momentum expended in order to produce this compression, and eP the momentum acquired during the restitution of the force of the bodies, e being the coefficient of elasticity. Let V and V' be the velocities of the balls when collision ceases. Hence, we have the three following cases:—

(1) mv = momentum of m at the beginning of collision.
P = momentum spent in producing compression.
mu = momentum of m when compression is a maximum.

(2) $m'v'$ = momentum of m' at the beginning of collision.
$m'u$ = momentum of m' when compression is max. $\therefore m'u' = m'u - P$.

(3) At the instant when collision ceases, we have similarly—

$$mV = mu - eP$$
$$m'V' = m'u + eP$$

From which equations we shall get—

$$u = \frac{mv + m'v'}{m + m'} = \frac{mV + m'V'}{m + m'}$$

$$P = \frac{m\,m'}{m + m'}(v - v')$$

$$V = \frac{mv + m'v'}{m + m'} - \frac{em'}{m + m'}(v - v')\text{; and}$$

$$V' = \frac{mv + m'v'}{m + m'} + \frac{em}{m + m'}(v - v').$$

In oblique impact, it must be assumed that the mutual action of the balls during collision is along the line which joins their centres at the instant when compression is at a maximum, and [illegible] that line only; that is, we assume the [illegible] smooth. Hence, [illegible] obliquely on a smooth plane, the [illegible] the plane will be perpendicular to its surface, and the momentum of the impinging ball will be affected along that line only. For further information, the reader had better consult Professor Walker's treatise on Mechanics, where he will find the subject treated on at length.

IMPALEMENT, *im-pail'-ment* (from Lat. *in* and *palus*, a stake), a mode of punishment which was practised formerly by the Turks and other uncivilized nations. It consisted in thrusting a stake through the body, and thus leaving the victim to a lingering death. Instances are recorded of persons who endured this horrible torture for several days, before death released them from their sufferings. It is stated by Mr. Layard in his "Nineveh," that impalement was commonly practised by the Assyrians towards their captives, and that the instrument of punishment, the stake, was thrust through the body immediately under the ribs (vol. ii. p. 374). When Darius took Babylon, he impaled no less than 3,000 prisoners, as is stated by Herodotus (iii. 159). Impalement is said to be still in use in the East, the Chinese being the people amongst whom it is most employed as a mode of punishment.

IMPANATION, *im-păn-ai-shun* (Lat. *panis*, bread), in Theol., is a term used to signify the opinion of the

Lutherans with respect to the sacrament of the Lord's supper; but which was held by others long before the time of Luther According to this view, the body and blood of Christ become united with the elements of the eucharist without any change in their nature. "The body," according to Luther, "is really present in the bread, the substances being in each case so mixed together, that each retains its own proper operation and nature, and yet together they constitute a single object."

IMPARLANCE, *im-par'-lânse* (Fr. *parler*, to speak).—Formerly, a defendant in a suit at law was entitled to demand one imparlance, or *licentia loquendi*, and might have more granted by consent of the court, before he pleaded, to see if he could end the matter by talking with the plaintiff, without further suit. It is now discontinued.

IMPATIENS, *im-pai'-shens*, in Bot., a gen. of the nat. ord. *Balsaminaceæ*. The species *I. balsamina* is commonly known as the Balsam, and is one of the most beautiful of garden annuals, forming a showy cone of finely-variegated carnation-like flowers. Those are regarded as the most choice varieties which have the flowers double and striped, but none of the varieties are permanent, or can be continued by seeds. The prevailing colours of the petals are white and red, the latter extending to every shade of orange, scarlet, purple, lilac, pink, and especially carnation, or flesh-colour. The way to procure very large plants is to sow early in the season, as in March; to commence transplanting into three-inch pots, as soon as the plants have two proper leaves; and to shift every week or ten days into pots a size larger every time, until at last they are in very capacious ones, and in the richest light mould. *I.* [illegible], the touch-me-not, is the only species found [illegible] When the seeds are ripe, the slightest touch will cause the capsule to burst with elastic force; hence the names *impatiens* and *nolitangere*.

IMPEACHMENT, *im-peetsh'-ment* (Lat. *impeto*, I prosecute), in Law, is a prosecution before the Lords, by the Commons in parliament, of persons accused of treason, or high public crimes, and misdemeanours of an inferior description. A commoner cannot, however, be impeached before the Lords for any capital offence, but only for high misdemeanour a peer may be impeached for any crime. The first regular instance of this proceeding appears in the reign of Edward III., when the king demanded the earls, barons, and peers, to give judgment against Simon de Bereford, who had been an accomplice in the treason of Roger, earl of Mortimer. Previous to that time, the Lords seem to have exercised a kind of irregular jurisdiction over state offences. In 1376, the Commons first appear as public prosecutors. For some time after this, cases of impeachment were common; but from the reign of Edward IV. down to Elizabeth, no instances occur, bills of attainder, and prosecutions in the Star Chamber, being the means usually resorted to for the punishment of state offenders. In the reign of James I., the practice of impeachment was revived, and has been continued since, the last memorable instances being Warren Hastings in 1788, and Lord Melville in 1805. The mode of procedure is briefly as follows:—A member of the House of Commons charges the accused with certain high crimes, and moves that he be impeached. If this is agreed to, the member is ordered to go to the bar of the House of Lords, and there impeach the accused. Articles of impeachment are then drawn up, and, having met with the sanction of the house, are laid before the House of Lords. The accused replies to them, and then a day is nominated for the trial, and managers are appointed to conduct the prosecution on behalf of the Commons. It is enacted (12 & 13 Will. III. c. 2) that no pardon under the great seal shall be pleadable to an impeachment by the Commons; but this does not affect the prerogative of the crown in granting pardon after judgment on an impeachment. The decision is come to by the lord high steward taking the opinion of each member on each article, beginning with the junior baron.

IMPENETRABILITY, *im-pen-e-tra-bil'-e-te* (from Lat. *impenetrabilis*, impenetrable), a term applied to one of the properties of matter, inferred by experience, and resting on the fact that, at the same instant of time, no two bodies can occupy the same portion of space. When an attempt is made to place one solid body in the part of space occupied by another, it is either resisted by the latter, or the latter is removed. Impenetrability is therefore only another name for this resistance. As regards solid bodies, the property requires no proof, being obvious to the touch. The property can also be proved for liquids by very simple experiments. If a solid body is immersed in a vessel brimful of water, it will displace a quantity of water equal to its own bulk; and if a cork be forcibly pressed into the neck of a bottle full of water, the bottle will burst. The impenetrability, however, of all matter can only be taken in conjunction with the hypothesis of its porosity. Otherwise the existence of the property might be successfully disputed. Sugar or salt may be dissolved in water without increasing the bulk of the fluid. Matter, in such cases, must be permeated, or else the matter of the fluid has pores or interstices. The researches of science will doubtless throw a clearer light upon impenetrability, the definition of which rests at present wholly on an assumption.

IMPERATIVE MOOD, *im-per'-ă-tiv* (Lat. *impero*, I command), in Gram., is that part of the verb which is employed in commanding, exhorting, entreating, or permitting; as, Depart in peace, Avoid evil companions.

IMPERATOR, *im-per'-ă-tor* (Lat.), according to Tacitus (Annal. iii. 74), a title bestowed among the early Romans by the acclamations of the soldiery, and afterwards by a vote of the senate, on a commander-in-chief who had signalized himself by killing a certain number of the enemy in battle The consuls them[illegible]es originally bore the title of imperator before they [illegible]e called *consuls*. After the republic was overthrown, imperator became the highest title of the supreme ruler,—whence the modern word emperor was brought into use (*See* EMPEROR.)

IMPERFECT NUMBER, *im-per'-fekt* (Lat *imperfectus*), a number, the sum of whose aliquot parts or divisions is not equal to itself. It is the reverse of a perfect number, whose parts, when added together, are equal to it. Thus 12 is an imperfect number, for example, as its divisors, 1, 2, 3, 4, 6, amount to 16, which is over 12,—which latter number is therefore deemed imperfect (*See* NUMBERS, PROPERTIES OF.)

IMPERFECT TENSE, in Gram., is that tense, or part of a verb, which expresses the action or event of which we speak, as at a certain time, to which we refer, in an unfinished or imperfect state; as, I was reading when he arrived.

IMPERMEABILITY, *im-per-me-ă-bil'-e-te* (Lat. *in*, not; [illegible]) some substances resist the passage of other substances through their mass. Thus glass is impermeable, for its pores are so small that no pressure hitherto applied has been able to drive fluids through them. Gold, however, is permeable, as was proved in the experiment of the Florentine Academicians. In endeavouring to determine whether water was compressible, they filled a hollow sphere of gold with it, and then applied great pressure to the surface; the consequence of which was, that the water was forced out through the pores of the gold. Some substances are impermeable on account of their repulsion to other bodies: thus oil-skin, or water-proof cloth, is impermeable to water.

IMPERSONAL VERBS, *im-per'-so-nal* (Fr. *impersonnel*), in Gram., are such as are used only in the third person; as, It rains, it snows, it thunders. The word impersonal, however, as implying a total absence of persons, cannot, with strict propriety, be applied to these verbs, nor, indeed, to any verbs; and hence some grammarians reject the name altogether

[illegible], to infest), in Med., is an eruption of [illegible] pustules, appearing in clusters, and terminating in a yellow, thin, scaly crust. It is also known as humid or moist tetter, and discharges a thin acrid ichor. It occurs on all parts of the body, but most commonly on the extremities. A variety of it is produced by the action of certain irritants upon the skin, as on the hands of those who work among sugar, known as the grocer's itch; also on the hands of bricklayers, known as the

bricklayer's itch. The eruption is not contagious. Cleanliness, cooling ointments, and mild aperients, are recommended by way of cure.

Impetus, *im'-pe-tus* (Lat.), in Mech., a term which signifies the same thing as *momentum*, or quantity of motion; and is generally estimated by the product of the velocity and mass of the body. This subject, however, has led to considerable controversy among philosophers; some estimating it by the mass into the velocity, while others maintain that it varies as the mass into the square of the velocity. This difference seems to have arisen from a misconception of the term rather than from any other cause; those who maintain the former opinion consider impetus, or momentum, to signify the momentary impact, and the latter the sum of all the impulses till the motion of the body ceases. In Gunnery, *impetus* is the altitude through which a body must fall in order to gain a velocity equal to that with which the ball is discharged from the gun.

Implication, *im-pli-kai'-shun* (from Lat. *implico*, I enfold), in Law, denotes something inferred, without being expressed directly in words; as where a man devises lands to his heirs at law after the death of his wife, the latter is said to have an estate for life by implication, though no estate is given to her in express terms.

Imports and Exports. (*See* Commerce.)

Imposition of Hands. (*See* Hands, Imposition of.)

Impost. (*See* Taxation.)

Impregnation. (*See* Reproduction of Plants and Animals.)

Impressment, *im-press'-ment*, in Law, is the forcible levying of seamen for service in the royal navy. The practice of impressing and granting powers to the Admiralty for that purpose is of very ancient date, though no statute has expressly declared this power to be in the crown, yet many of them very strongly imply it. The statute 2 Rich. II. c. 4, speaks of mariners being arrested and retained for the king's service, as of a thing well known and practised without dispute, and provides a remedy against their running away. The arguments against this system are given by McCulloch, in his edition of Smith's *Wealth of Nations*, note xii.

Imprimatur, *im-pri-mai'-tur* (Lat., let it be printed), is the permission granted by the censor, in those countries where a censorship of the press is established, for a book to be printed. The form was also used with books printed in England in early times, and even in the present day, books printed with the sanction of certain of the Scottish universities, as St. Andrew's, carry the "imprimatur" of the senatus academicus.

Imprimis, *im-pri'-mis* (Lat., in the first place), a word generally used in cataloguing a series of things, ideas, or arguments. It means "in the first place," and its application may be seen in several of Shakspere's plays, particularly in "Henry IV." It is somewhat out of date now in common phraseology.

Imprint, *im'-print* (from Fr. *imprimer*, to impress), the designation of the place where, by whom, and when a book is published, always placed under the title of the same. By the act 39 Geo. III. cap. 79, every printer is obliged to affix his name and residence to each article he shall print; and if it consists of more than one leaf, then upon the first and last leaves, under a heavy penalty: there are some exceptions to this law, however. In newspapers, the imprint is generally placed at the end of the last column of the final page. In books, the name of the printer is sometimes placed at the back of the title-page, and sometimes at the end of the work.

Imprisonment, *im-priz'-on-ment* (Fr. *emprisonner*), the restraint of a man's liberty under the custody, charge, or keeping of another. Imprisonment extends not only to a gaol, but to a house, stocks, or where a man is held in the street, &c.; for in all these cases the party so restrained is said to be a prisoner, so long as he hath not his liberty freely to go about his business as at other times. No man can be imprisoned except by the lawful judgment of his peers, or by the law of the land; and no man can be imprisoned except as the law directs, either by command and order of a court of record, or by lawful warrant, or the queen's writ, by which one may be lawfully detained to answer the law. (For further information on the subject of imprisonment, *see* Arrest, Bail, Constable, Commitment, False Imprisonment, and Habeas Corpus.)

Imprisonment, False. (*See* False Imprisonment.)

Impromptu, *im-promp'-tu* (Lat., in readiness), in Lit., is applied to something given out on the spur of the moment, or without premeditation, usually of a witty or epigrammatic character.

Impropriation, *im-pro-pri-ai'-shun*, in Law, is where the tithes, glebe, or other ecclesiastical dues of a parish, are in the hands of a layman; when such are annexed to any spiritual corporation, they are said to be appropriated.

Improvisatore, *im-pro-ve-za-to'-re* (Ital., unpremeditatedly), is a term applied to one who has the power of composing and reciting a number of verses upon any given subject without premeditation. The Italians particularly excel in this species of composition, owing, no doubt, in great measure, to the richness and flexibility of their language. The poetry, however, so produced is of no very high character, being chiefly remarkable for its natural flow of language and quick adaptation of ideas and images to the main subject. None of the poems so produced have acquired any permanent reputation. The improvisatore generally accompanies himself on the guitar while he is giving forth his verses. Several females have likewise distinguished themselves in this art, and [illegible] *provisatrici*.

Impulse, *im'-puls* (Lat. *impulsus*), the force of one body communicated to another in a continuance of motion after the force has been withdrawn. When a body rolls down a gently-inclined plane, it is possible to see the gradual changes in its velocity, and it is apparent that between the instants at which the body has two different velocities it takes in all intermediate velocities, or that the change of velocity is perfectly gradual. But when a body is violently struck, as in the case of a ball by a cricket-bat, no gradations of velocity are seen; but the ball appears to change from a point of rest, as it were, to a state of rapid motion, without passing through any of the intermediate states. In this case it is said to receive an impulse, which may, therefore, be said to be any cause by which velocity is communicated suddenly and without gradations.

Inauguration, *in-aw-g-u-rai'-shun*, a word borrowed from the ceremonies used by the Romans when they were re[illegible]ed into the college of Augurs, and applied the [illegible] inducting into office with ceremony. Kings [and] emperors are *inaugurated* by coronation, prelates by consecration; and other important officers by such ceremonies as give authority to the transaction.

Inca, *in'-ka*, the title borne by the kings and princes of the blood of the ancient kingdom of Peru.

Incandescence, *in-ken-des'-ens* (Lat. *incandescens*), the luminous glow given by a substance when intensely ignited. Ignition and incandescence are properties belonging to some bodies, by which they give out light when raised to certain high temperatures; the quantity of [illegible] e light at first [illegible] what is called cherry-red heat: it becomes orange-coloured or yellow at a higher temperature; and, lastly, a white heat, when the light becomes painful to the eye. The degree at which incandescence begins to be visible in the dark was placed by Sir Humphrey Davy's experiments at 810° Fahr.; but a dull red heat, visible at daylight, is probably about 1,000°; a cherry-red heat, 1,200° [illegible] heat, 1,700°; and a white heat, 3,000°. According to Daniell's pyrometer, the high white heat of a good wind-furnace is 3,300°.

Incarnation, *in-kar-nai'-shun* (Lat. *caro*, flesh), in Theol., is a term used to denote the taking upon him of our human nature by Christ Jesus. What the nature of this union of the human and the divine was, we have no means of knowing, that such a union actually did take place, we have the clearest evidence in scripture; for St. John says "The word was made flesh, and dwelt among us." Yet many sects have arisen, who have maintained the contrary, and held that the Son of God did not take human nature upon him; as the Arians, Socinians, Nestorians, &c.

INCENDIARY, *in-sen'-de-a-re* (Lat. *incendo*, I burn), is one who wilfully sets fire to the house, or other property, of another person. It is also used in a metaphorical sense to denote a political agitator, one who goes about to inflame people's minds against the government.

INCENSE, *in'-sens* (from Lat. *incendere*, to burn), a dry resinous compound, which, when burnt, produ[illegible] a pleasant perfume. According to Bingham, the use of incense in connection with the Eucharist was unknown in the Church until the time of Gregory the Great, in the latter part of the 6th century. It then became prevalent, but has long been disused in the Church of England; although it is still adopted by the Romish church. Amongst ancient pagan nations, the perfume of incense was generally offered to the gods, and as the representat[illegible] of God, the Persians used to burn incense before the king. The word used to denote incense arising from s[illegible] also used in Hebrew to denote the smoke arising from the fat of burnt sacrifices. The incense used by the Jewish priests was a compound of stacte, onycha, galbanum, and pure frankincense. This compound was to consist of equal parts of each ingredient, to be broken into very minute particles, which were to be deposited before the ark. It was to be used specially in the service of Jehovah, as its use in private life was specially forbidden (Exodus xxx. 34—38). The origin of incense in the Jewish form of worship, according to Maimonides, in "More Nevochim," quoted in an article on the subject in the "Encyclopædia Britannic[illegible] was to prevent the dis[illegible] of having such numbers of animals [illegible] sacrifice. The burning of the incense was proceeded with in the following manner:—The priests having drawn lots, to ascertain who should offer it, the person destined took a large silver dish, in which was a censer full of incense; and, being accompanied by another priest, carrying some live coals from the altar, went into the temple, where, in order to give notice to the people, he struck upon an instrument of brass, resembling a gong, placed between the temple and altar. Immediately after the burning of the holocaust (which *see*), the incense was set fire to, all the multitude without the temple continuing in pray[illegible] during the time that it was consuming.

INCEST, *in'-sest* (Lat. *incestum*, *i. e.* *non castum*, not pure), is the marriage, or living together as husb[illegible] and wife, of persons within certain degrees of consanguinity. During the Protectorate, incest was made a capital offence; but at the Restoration this law was abolished, and it is now cognizable only by the ecclesiastical courts.

INCH, *insh* (Ang.-Sax.), a lineal measure, the twelfth part of a foot, and equal to three barleycorns.

INCH OF CANDLE. (*See* AUCTION.)

INCIDENCE, ANGLE OF, *in'-se-dens* (Lat. *incido*, I fall upon), a term used in Catoptrics, &c., to express the angle between the direction in which a line strikes on a plane and the perpendicular to that plane. When rays of light striking a body are reflected, the angles of incidence and the angles of reflexion are said to be equal. The *point of incidence* is that point in which a ray of light is [illegible]posed to fall on a piece of glass. *Line of incidence*, is that line in which light is propagated from a radiant point to a point in the surface of the speculum, otherwise called the *incident ray*.

INCISORS, *in-si'-zors* (Lat. *incisores*, fr. *incido*, I cut), in Anat., is the name given to the four front teeth in each jaw, so called from their use in cutting the food.

INCLINATION, *in-klin-a'-shun* (Lat. *inclinatio*), a term used to express the angle which two lines, or planes, make with each other. Thus, two lines which make a very small angle are said to have a very small inclination to one another. Inclination is therefore synonymous with angle, and the angle of *incidence* is the technical term for what should properly be called the angle of inclination.

INCLINED PLANE, *in-klined' plane*, one of the five simple mechanical powers in statics, the theory of which can be easily deduced from the proposition termed "the decomposition of forces." If a body be placed on a horizontal plane on which there is no friction, it stands to reason that the body will be entirely supported, and that any horizontal pressure however small, will cause motion. If the same plan[illegible] be made vertical instead of horizontal, the weight cannot be placed upon it; for if the heavy body were made to touch the plane and then left to itself, it would fall down the plane, exactly in the same manner as it would fall if there were no plane; that is, if it be supposed that no friction exist. It follows, consequently, that if the plane be made to assume an oblique or inclined position, the effect produced will be intermediate between those of the two preceding cases; for the weight will not rest, nor will it acquire velocity as rapidly as when it falls freely. The inclined plane, then, is a plane which forms an angle with the horizon. The force which accelerates the motion of a heavy body on an inclined plane is to the force of gravity as the sine of the inclination of the plane to the radius, or as the height of the plane to its length. If f = force accelerating the body on an inclined plane, of which the inclination is ι, and if g = force of gravity, it will be found that $f = g \times \sin \iota$. Hence the motion of a body on an inclined plane is accelerated in a uniform manner. If two bodies begin t[illegible] descend from rest, and from the same point, the one on an inclined plane and the other falling freely to the ground, their velocities, at equal heights above the earth's surface, will be equal. Hence the velocity acquired by a body in falling from a rest through a given height is the same, whether it fall freely or descend on a plane with any inclination whatever. When a power acts on a body on an inclined plane, so as to keep that body at rest, then the weight, the power, and the pressure on the plane, will be as to the length, the height, and the base of the plane, when the power acts parallel to the inclined surface; from which the following rules can be deduced:—

$$\text{The power} \ldots\ldots\ldots\ldots = \frac{\text{weight} \times \text{height of plane}}{\text{length of plane}};$$

$$\text{Weight} \ldots\ldots\ldots\ldots = \frac{\text{Power} \times \text{length of plane}}{\text{height of plane}};$$

$$\text{Pressure on the plane} = \frac{\text{weight} \times \text{base of plane}}{\text{length of plane}}.$$

These rules express, however, the conditions of equilibrium, and it is obvious that if either the weight or the power be increased (friction excepted), motion of the body must ensue. (*See* STATICS.)

INCLOSURE, *in-klo'-zhur*, a term applied to the closing in and partitioning of those lands in England and Wales which are comprehended under the title of commons or common lands. Before inclosures were made, the land used for agricultural purposes was of [illegible] kinds,—commons, commonable, and intermixed lands. The first of these are lands in a state of nature, [illegible]aste, of which no individuals have the severalty. Commonable lands are those which are in severalty [illegible] a portion of the year; that is to say, they are occupied severally by individuals as their own, other people being excluded for the time. Lands of this sort, exclusive of wood-lands, are of three kinds. First, open [illegible] and meadow land, held severally by intervals till the gathering in of the crop. After that time it becomes commonable to persons who have severalty rights in it, and they turn their cattle on it. Second, there is open arable and meadow land that is held in severalty for a part of the year, like the first class, but, after the removal of the crop, it is not only commonable to those parties who have severalty rights, but also to other classes of individuals. Lands of this sort are usually called Lammas lands. Commonable rights either belong to a particular class, as a body of freemen, or to all landholders. Many of the ancient usages of England, like to this, bear a close resemblance to those of the nations usually called barbarous. Tacitus mentions a similar custom as commonable rights amongst the ancient Germans; Cæsar among the Gauls; Herodotus among the Egyptians; and Strabo among the Dalmatians. The third class is that of grazing lands, where the rights of parties are settled and defined to the ordinary stinted pasture, but are subject to very varied and peculiar regulations. It is obvious that common fields must be ill-cultivated under a system such as this. Intermixed lands can[illegible]t be treated according to the laws of good farming. It is said that the simple redistribution of intermixed

lands, now held in inconvenient lots, would raise the fee-simple value of the lands in many instances from 15s. to 30s. In 1844, it was the opinion of witnesses examined on the commons' inclosure, that judicious inclosure would make a large portion of common land much more productive. They also showed that effectual drainage was impossible in some intermixed open arable lands. Before that time, in 1836, an act (6 & 7 Will. IV. c. 115) was passed for facilitating the inclosure of open and arable fields in England and Wales. The provisions of this act are limited, since it "applies solely to lands held in severalty during some proportion of the year, with this exception, that slips and balks intervening between the cultivated lands may be inclosed." The lands which cannot be inclosed under the act, are "the uncultivated lands, the lands in a state of nature, intervening between these cultivated lands, beyond those that are fairly to be considered as slips and balks." In 1844, a select committee of the House of Commons was appointed "to inquire into the expediency of facilitating the inclosure of commons and lands held in common, the exchange of lands, and the division of intermixed lands, and into the best means of providing for the same, and to report their opinion to the House." An act in accordance with the objects of this inquiry was passed in 1845 (8 & 9 Vict. c. 118). The provisions of this act appear to be perfectly able to meet the evils it was intended to counteract, and agriculture has, without doubt, greatly benefitted by its action.

IN CŒNA DOMINI, *in se'-na dom'-i-ni* (Lat., at our Lord's Supper), is the name of a celebrated papal bull, one of the most arrogant and pretentious of all that have issued from the papal see. Founded on more ancient papal decrees, it was first given forth by Pope Urban V. (1362-70), and afterwards renewed and altered by Pius V. (1567) and Urban VIII. (1627). It lays down the claims of the Church, and promu[lgates] ... to be read annually in all the churches every Holy Thursday, but this is now only takes place at Rome.

INCOGNITO, *in-kog'-ne-to* (Lat., unknown), is commonly applied to a prince, nobleman, &c., travelling in such a way as not to be recognized or known, which is usually done by assuming a feigned name, and dispensing with retinue or other marks of distinction.

INCOMBUSTIBLE SUBSTANCES, *in-kom-bus'-ti-bl* (Lat.), are those which have been so prepared as to be incapable of being kindled or of being consumed by fire. Cloth made of the fibres of asbestos, by weaving, will bear a considerable heat without injury. Incombustible cloth is also made by preparing cotton and linen fabrics with solutions of borax, phosphate of soda, phosphate of ammonia, or sal-ammoniac. Cloths so prepared may be placed in contact with ignited ... , active combustion or bursting into flames. Tungstates of the alkalies have also been successfully used for similar purposes. All these substances act by forming a species of glaze on the surface of the fibres, which excludes them from the air. They do not, however, prevent carbonization from taking place when the temperature is very high. Solutions of alum and common salt have also been used for similar purposes; and, latterly, a starch mixed with sulphate of zinc and sulphate of ammonia.

INCOME-TAX. (*See* TAXATION.)

INCOMMENSURABLE QUANTITIES, *in-kom-men'-su-ră-bl*, are those which are so related that while one is capable of being represented in the terms of a certain ... the other is ... The reason of this is thus stated. Any two wh[ole] ... must have a common measure: thus all whole numbers have the common measure 1, and any two fractions $\frac{a}{b}$ and $\frac{p}{q}$ (a, b, p, and q, being whole numbers), have the common measure $\frac{1}{bq}$, which is contained exactly aq times in the first and bp times in the second. Conversely, any two magnitudes which have a common measure can be arithmetically represented by the same unit, for if A and B have the common measure m, and if this measure be contained 7 times in A and 10 times in B, then it is evident that by taking m as the unit, A is represented by 7 and B by 10. If, therefore, there be two magnitudes which cannot be represented by means of the same unit, they cannot have any common measure whatsoever, and are therefore *incommensurable*. (*See* IRRATIONAL QUANTITIES.)

INCREMENT, *in'-kre-ment* (Lat. *incrementum*), a term used in the calculus to express the increase in the function of any quantity by an infinitely small quantity, in opposition to *decrement*, which is of directly the reverse signification. In old English writers, the differential calculus is sometimes called the "method of increments." (*See* INTEGRAL CALCULUS.)

INCUBATION. (*See* HATCHING.)

INCUBUS, or NIGHTMARE, *in'-ku-bus* (Lat., from *incubo*, I lie upon), is a distressing sensation sometimes experienced during sleep, and usually accompanied by frightful dreams. The patient is pursued by some enemy or wild beast, or endeavours to escape from some danger, but cannot, there is a dreadful weight upon his chest; he strives to cry out, but is unable; at length he awakes in terror, and feels great relief. Nightmare is most frequently caused by a heavy supper just before going to bed; dyspepsia, mental irritation, great fatigue, lying in an uneasy position, may all occasion it. The cure is avoidance of these causes and attention to the state of the stomach.

INCUMBENT, *in-kum'-bent* (from Lat. *incumbo*, I lie upon, or occupy), a term applied to the holder of an ecclesiastical benefice.

INCUNABULA, *in-ku-nab'-u-la* (Lat., a cradle), in Bibl., is a term applied to early books, printed before the year 1500. The most complete catalogue of these [boo]ks is given in Hain's "Repertorium Bibliographicum," 2 vols., Stuttg. 1826-38.

INDECLINABLE, *in-de-kli'-na-bl* (Lat. *indeclinabilis*), in Gram., is applied to a word which admits of no declension or inflection; as adverbs, prepositions, conjunctions. In Latin and Greek, indeclinable nouns are ...

INDEHISCENT, *in-de-his'-sent* (Lat. *in*, not, and *dehisco*, I gape), a term applied in Bot. to a fruit, the pericarp of which ... , as in the hazel-nut. When it separates regularly round its axis, either wholly or partially, into several pieces, the separation is called *dehiscence*, and such pieces *valves*; and the axis from which the valves separate, when there is a distinct axis, is called the *columella*.

INDEMNITY, *in-dem'-ne-te* (Lat. *in* and *damnum*, loss), denotes, in a general sense, the making good, or compensating for any loss. An act of indemnity is necessary to be passed by parliament, when ministers, in order to meet some sudden and unforeseen emergency when parliament is not sitting, adopt measures which are not strictly within their constitutional powers.

INDENTED, *in-dent'-ed* (Lat. *dens*, a tooth), one of the eight lines of partition used in Her. for dividing one part of the field of the shield from another, or for forming the outline of any ordinary or sub-ordinary. It consists of a zigzag line, resembling the teeth of a ...

[I]NDENTURE, *in-dent'-shur*.—In Law, if a deed be made by more than one party, there ought to be regularly as many copies of it as there are parties, and, until recently, each was, or should have been, cut or indented (formerly in acute angles, *instar dentium*, like the teeth of a saw, but more usually in a waving line), the top or side, to tally or correspond with each [oth]er, which deed so made is called an indenture. Now, [how]ever, since 1845, a deed ... to be an indenture shall have the effect of an indenture although not actually indented.

[INDEPENDENCE, DECLARATION OF, in-de-pen']-dens, in the h[istory of] the United State[s] of America, was that declarati[on] which was ... and adopted by Congress, on 4th July, 1776, declaring the freedom and independence of the American colonies, and their absolution from all allegiance to Great Britain. A committee of five was appointed to draw up this document; namely, Jefferson, Adams, Franklin, Sherman, and Living[s]t[o]n; but it was mainly the work of Jefferson.

INDEPENDENTS, or CONGREGATIONALISTS, *in-de-pen'-dents, kon-gre-gai'-shun-ăl-ists*, is the name of a large and influential sect of English Protestant dissenters. They take the name of Independents, because they hold that every single congregation of Christians,

when properly constituted with deacons and a pastor, forms an independent body, competent to its own direction and government, without interference from any other church, or any presbyteries, bishops, &c. They therefore hold that each congregation has inherent in itself power to fix its own tenets and form of religious worship, and to exercise ecclesiastical government. They hold a Christian church to be a congregation of true believers; *i. e.*, persons who both openly profess their faith in the essential doctrines of the Gospel, and evince the earnestness of their belief by a corresponding change of disposition and demeanour. They have only two descriptions of church officers,—pastors and deacons; the former to promote the spiritual, the latter to advance the temporal welfare of the church. The only valid call to the pastorate is held to be an invitation to that office by an individual church; and to a person so invited, no license nor ordination is considered requisite, in order to confer authority to preach, or to administer the sacraments. Still, after this election by an individual church, an ordination by ministers of the neighbouring churches is general, when the newly-chosen pastor makes a profession of his belief, and receives fraternal recognition from the other pastors present. In the selection of its minister, a church is not restricted to a special class prepared by education for the office; yet an educated ministry is considered very desirable, and practically almost all the Congregational ministers in modern times receive preparatory training at some of the theological academies belonging to the body. Religious exhortation is permitted and encouraged in all those who, having gifts appropriate, feel prompted to use them. The doctrines of the Congregational churches are almost identical with those embodied in the Articles of the established church, interpreted according to their Calvinistic meaning. They are opposed to all state interference in religious matters, and to all state endowments for religious purposes. They disavow all subscription to creeds, confessions, or articles of faith; nevertheless, they are distinguished by a singular degree of uniformity in faith and practice. The "Declaration of Faith, Order, and Discipline," issued by the Congregational Union in 1833, though not binding upon any of the churches, is believed to be dissented from by none. The Congregational Union of England and Wales was founded in 1831. It is a delegated conference of ministers and laymen, meeting twice a year, for consultation on the state and prospects of the body; the constitution providing that it "shall not in any case assume a legislative authority, or become a court of appeal." As to the origin of Independency, it is probable that some conventicles were secretly established soon after the accession of Elizabeth; but the first prominent advocate of Congregational principles appeared in 1580, in the person of Robert Brown. (*See* BROWNISTS.) His followers rapidly increased, so much so, that an act of parliament was passed in 1593, specially directed against them. They were treated with great rigour, and several suffered martyrdom for their opinions in the reign of Elizabeth. Many were driven to the continent, and churches were established at Amsterdam, Rotterdam, Leyden, and other parts; Mr. Robinson, who was [illegible] of the church at Leyden, being frequently re[illegible] as the real founder of Independency, as he [illegible]ed many of the principles of the Brownists. [illegible] Jacob, one of the exiles, returned to England in 1616, and established an Independent church in London. During the Long Parliament, they enjoyed a season of comparative freedom, meeting openly, and gathering strength; and when Cromwell (himself an Independent) assumed supreme authority, their principles obtained a potent recognition, and a general toleration was in a great measure effected. With the Restoration, however, their prosperity came to an end, and by the Act of Uniformity in 1662, about 2,000 non-conforming clergymen were excluded from their places in the church. The Revolution of 1688 again brought them comparative freedom, which was confirmed by the Toleration Act of the following year. Yet, for some time after this, Independency did not flourish; and indeed it was not till the revival of religion, exhibited by the labours of Wesley and Whitfield, that it again began to prosper; and since that time it has gone on greatly increasing the number of its adherents. They have upwards of 1,600 churches in England, 630 in Wales, and 150 in Scotland and the Channel islands. They have also a number of colleges and educational seminaries for the training of young men for the ministry, in different parts of England, and at Edinburgh.

INDETERMINATE COEFFICIENTS, *in-de-ter'-min-ate*, a form of analysis, said to have been invented by Descartes, which is much used, even in the highest branches of mathematics. The system is based on the following formula:—If $A+Bx+Cx^2+$ &c. $= a+bx+cx^2+$ &c., be an identical equation, that is, if it hold for all values whatever of x, then the coefficients of like powers of x are equal to each other; that is, if $A=a$, $B=b$, $C=c$; and so on. For if $A+Bx=a+bx$, then $A-a+(B-b)x=0$, an equation which admits of one value of x only; unless $B-b=0$, or $B=b$, when also $A-1$ will be $=0$, or $A=a$. Again, if $A+Bx+Cx^2=a+bx+cx^2$, then $A-a+(B-b)x+(C-c)x^2=0$, a quadratic equation which admits of but two solutions to the distinct values of x. The application of indeterminate coefficients may be seen by the manner in which the following fraction $\frac{a-bx}{a+cx}$ can be expanded to four or more terms by the aid of the theory. Let—

$$\frac{a-bx}{a+cx} = A+Bx+Cx^2+Dx^3+ \text{\&c.}$$

Then, $a-bx=Aa+Bax+Cax^2+Dax^3+$ &c.
$+Acx+Bcx^2+Ccx^3+$ &c.; or, $a-bx$
$=Aa+(Ba+Ac)x+(Ca+Bc)x^2+(Da+Cc)x^3+$ &c.
Whence, by equating the coefficients of the like powers of x, we find that $Aa=a$, or $A=1$;

next, $Ba+Ac=-b$, $\therefore Ba=-(b+c)$, or $B=-\frac{b+c}{a}$;

then, $Ca+Bc=0$, $\therefore Ca=\frac{b+c}{a}\cdot c$, or $C=\frac{b+c}{a^2}\cdot c$;

lastly, $Da+Cc=0$, $\therefore Da=-\frac{b+c}{a^2}\cdot c^2$, or $D=-\frac{b+c}{a^3}\cdot c^2$;

consequently, we gain the result that—

$$\frac{a-bx}{a+cx} = 1-\frac{b+c}{a}x+\frac{b+c}{a^2}cx-\frac{b+c}{a^3}c^2x^3+ \text{\&c.}$$

The application of indeterminate coefficients thus enables the student to solve questions by ordinary algebra that would otherwise come under what is termed infinitesimal analysis. (*See* FLUXIONS and INTEGRAL CALCULUS.)

INDETERMINATE EQUATIONS, a mathematical term applied to problems which are capable of more than one solution, in consequence of there being more unknown quantities than independent equations. The rule for solving these may be thus given:—If a simple equation express the relations of two unknown quantities, and their corresponding integral values be required, divide the whole equation by the coefficient which is the lesser of the two, and suppose that part of the result which is in a fractional form equal to some whole number; thus a new simple equation is obtained, with which we can proceed as before. Let the operation be continued until the coefficient of one of the unknown quantities is 1, and the coefficient of the other a whole number; then an integral value of the former may be obtained by substituting 0, or any whole number, for the other; and from the preceding equations integral values of the original unknown quantities may be found. For instance, let $5x+7y=29$, to find the corresponding integral values of x and y. Dividing the whole equation by 5, the lesser coefficient, we have—

$$x+y+\frac{2y}{5}=5+\frac{4}{5}$$

$$\text{or, } x=5-y+\frac{4-2y}{5}, \text{ a whole number;}$$

$$\therefore \frac{4-2y}{5}= \text{a whole number; say } p$$

$$\frac{4-2y}{5}=p; \text{ and } 4-2y=5p$$

$$\therefore y=2-2p-\frac{p}{2}, \text{ a whole number}$$

$$\therefore \frac{p}{2} \text{ is a whole number, say } S$$

$$\therefore y=2-5S, \text{ because } p=2S$$

Then, substituting 0 for the value of S,—

$y=2$, or a *minus* quantity,

and $x=3$, or some larger number that ratifies the equation, for S may be put equal to any whole number whatever. Conv[illegible] and other theories, are connected with [illegible] ate equations; and the reader is referred for full particulars to Legendre's works, which enter at length upon the subject.

INDEX, *in'-deks* (Lat. *indico*, I point out), in Bibl., is an alphabetical list at the end of a work, of the principal subjects treated of or contained therein, with a reference to the place where they are to be found. Nothing enhances the value of a book more than a good index, and there are few books, except those of a merely ephemeral character, that should be without one. Nor is the getting up of an index so simple a matter as it would at first sight appear. It requires a knowledge of the subject treated of, and some care in selecting the proper heads under which to enter the various topics.

INDEX, a term used both in arithmetic and algebra, to imply the power to which a number, or quantity, is to be raised. (*See* INVOLUTION.)

INDEX EXPURGATORIUS, and INDEX LIBRORUM PROHIBITORUM, *in'-deks eks-pur-gă-to'-re-us, li-bro'-rum pro-hib-e-to'-rum* (Lat., purified index (of books), index of prohibited books), is the catalogue of those books which the Roman Catholic church, on account of heresy, forbids to the laity. The catalogue of such books as are only heretical, or contrary to the principles of the Catholic church in certain parts, is called the *Index Expurgatorius*. As early as 1546, such catalogues were made public in Louvain, and soon after at Venice, Paris, Cologne, and other places. In 1559, Pope Paul IV. caused the Inquisition to publish a list of prohibited books; and this is the first Roman index proper. A regular form was prepared for them by the council of Trent, which received the approval of Pius IV. in 1564. The index of Trent was enlarged by Sixtus V. and Clement VIII., the former of whom appointed a special congregation at Rome for taking charge of it.

INDIA, ARCHITECTURE OF. (*See* HINDOO ARCHITECTURE.)

INDIAN BAEL. (*See* ÆGLE.)

INDIAN BREAD. (*See* PACHYMA.)

INDIAN CORN. (*See* ZEA.)

INDIAN CRESS. (*See* TROPÆOLUM.)

INDIAN FIG. (*See* OPUNTIA.)

INDIAN FIGTREE. (*See* FICUS.)

INDIAN FIRE, in Chem., a bright white fire, used in pyrotechny, composed of—sulphur 7 parts, realgar 2 parts, and nitre 24 parts.

INDIAN HEMP. (*See* CANNABIS.)

INDIAN INK. (*See* INK.)

INDIAN MILLET. (*See* PANICUM.)

INDIAN SARSAPARILLA. (*See* HEMIDESMUS.)

INDIAN TEAK. (*See* TECTONA.)

INDIAN TOBACCO. (*See* LOBELIA.)

INDIA-RUBBER. (*See* CAOUTCHOUC.)

INDICATIVE MOOD, *in-dik'-ă-tiv* (Lat. *indico*, I point out), in Gram., is that particular form or state of a verb which simply indicates or declares a thing; as, I love, He is feared.

INDICTION, *in-dik'-shun* (Lat. *indictio*, establishment, order), in Chron., a period of fifteen years, different from other cycles, in the fact of its having no reference to astronomical phenomena. The indiction is supposed to relate to certain judicial acts, as tariffs of the taxes and such-like decrees, at stated intervals, under the old Greek emperors. The Cæsarean indiction fell on the 8th of the calends of October (24th September); the Constantinopolitan indiction on the 1st September; and the Pontifical indiction on the 1st January. The year of indiction may be computed by the following formula, to correspond with the year of our era:—Add 3 to the date, divide the sum by 15, and the remainder will be the year of the indiction. If the remainder be 0, it will signify the 15th of the cycle. The reader will find the subject fully discussed in Gibbon's "Decline and Fall of the [illegible] Empire."—*Ref.* Brande's *Dictionary*.

INDICTMENT, *in-dite'-ment* (Lat. *in* and *dico*, I speak against), in Law, is a written accusation of one or more persons, of a crime or misdemeanour, preferred to, and presented upon oath by, a grand jury. Indictments must have a precise and sufficient certainty. They should set forth the Christian name and surname, with the addition of the state and degree, town or place, and country, of the offender; but mistakes on these points are not generally held to be material. The time and place in which the fact was committed are also usually given; but neither is a mistake here generally held to be material. The offence itself must also be set forth with clearness and certainty. The grand jury sit and receive indictments; and their duty is only to hear evidence on behalf of the prosecution; for the finding of an indictment is only in the nature of an inquiry or accusation. They ought, however, to be thoroughly persuaded of the truth of an indictment, so far as their evidence goes, and not rest satisfied with mere probabilities. When, having heard the evidence, they think it a groundless accusation, they used formerly to indorse on the back of the bill "*Ignoramus*," or, "We know nothing of it;" now, they write, "Not a true bill," or "Not found," and then the party is discharged without further answer. A new bill may, however, be preferred against him before the same, or another, grand jury. If satisfied of the truth of the accusation, they then indorse upon it, "A true bill," anciently, *Billa vera*. The indictment is then said to be found, and the party stands indicted. In finding a true bill, twelve, at least, of the grand jury must concur.

INDIGESTION. (*See* DYSPEPSIA.)

INDIGO, *in'-di-go* (Fr., It., Sp. *indigo*), in Chem., a blue dyestuff, extracted from a variety of plants, growing principally in India and America, especially from species of *Indigofera* (which *see*). The common woad, or *Isatis tinctoria*, also yields indigo. It has been found in minute quantities in the milk of cows and in human urine. It is one of our most important dyestuffs, both from the beauty and permanence of the colour it yields, and from the ease with which it is applied to fabrics of all materials. The juices of the plants from which indigo is obtained give no evidence of its presence while in their natural state, but require to undergo a process of fermentation before the dark-blue colouring matter, known in commerce as indigo, is precipitated. The method of manufacture consists in steeping the plant in water until fermentation sets in, the colouring matter dissolves in the water, forming a yellow solution, which is drawn off from the rest of the vegetable matter. This solution, by agitation and continual exposure to the air, gradually deposits indigo as a blue precipitate, which is dried, and pressed into the form in which it is sold to customers. India and the islands of the Indian Archipelago produce four-fifths of the indigo consumed, the remainder being furnished principally by Central America, only a very small proportion being found in other parts of the world. The indigo of commerce contains *indigotine*, or indigo-blue, its most important constituent, indigo-brow[illegible] indigo-red; besides many other substances, in [illegible] proportions, which must be looked on as [illegible] impurities or adulterations. Indigotine, or indigo-b[illegible] may be obtained in crystals from the red or brown colouring matter, by sublimation between two watch-glasses; but as this process is attended with considerable loss, the following method is usually adopted in commerce:—Four ounces of commercial indigo in fine powder, and four ounces of grape sugar, are placed in a flask capable of holding, at least, ten pints of liquid; and six ounces of a saturated solution of caustic soda is added to them, and the flask filled up with boiling alcohol. The mixture is shaken, the flask being first closed, so as to exclude the air, and set aside. In a few hours it becomes clear, and the yellowish-red solution is drawn off, and exposed to the air. It becomes brown, and deposits crystals of indigotine, which are rendered perfectly pure by treatment with boiling alcohol and hot water. Pure indigotine is not soluble either in water, weak acid, or alkalies. In order, therefore, to use it as a dyestuff, it has to be reduced to the state of white indigo, which is readily soluble by means of copperas and potash, or some other deoxidizing agent. White indigo contains one equivalent more of hydrogen than blue indigo, and is

soluble in alkaline liquids. The processes for dyeing fabrics with indigo are consequently all founded on the same principle—the use of a deoxidising agent for reducing the blue indigo to white, and an alkaline solution for dissolving it when formed. The indigo is, therefore, fixed in the fibre in its white and soluble condition, the blue colour being afterwards developed by exposure to the air. Indigotine dissolves readily in sulphuric acid, forming *sulphindylic acid*, known in dyeing as sulphate of indigo, or Saxony blue. Schunck supposes that the indigo obtained from woad is the result of the decomposition of a yellow, transparent, amorphous, deliquescent substance, which he has extracted from the juice, and which he names *indican*. When heated with sulphuric acid, it forms indigo-blue, indigo-red, and a species of sugar. This appears to be exactly what happens during the fermentation of the indigo plants; a strong acid is developed, which converts the indican into indigo-blue, indigo-red, and sugar. Under different treatment, indigo-blue yields a variety of substances, a full account of which will be found in Miller's *Elements of Chemistry*, vol. iii.

INDIGOFERA, *in-di-gof'-e-ră* (*indigo*, and Lat. *fero*, I bear), in Bot., a gen. of the papilionaceous division of the nat. ord. *Leguminosæ*. The species *I. tinctoria*, *cærulea*, and probably some others, yield commercial indigo, one of the most important of dyeing materials. Indigo is very poisonous; but in proper doses it has been employed in epilepsy and erysipelas; its value in such diseases is by no means well established. (*See* INDIGO.)

INDIRECT TAXES. (*See* TAXATION.)

INDIVISIBLES, *in-de-viz'-e-bls*, a peculiar method of the calculus invented by Cavalieri, a disciple of Galileo, which was much used by mathematicians before the invention of fluxions and the differential and integral calculus. In this theory, lines are considered to be composed of an infinite series of points, surfaces of an infinite number of lines, and solids of an infinite number of surfaces. The purpose, therefore, of the method is to give an infinite series of successive approximations, and it is extremely useful in discovering the contents and areas of innumerable plane and solid figures. (*See* FLUXIONS, INTEGRAL CALCULUS.)

INDO-GERMANIC, INDO-EUROPEAN, or ARYAN LANGUAGES, *in'-do-jer-măn'-ik*, are the different names given by different philologers to one of the three great families into which the tongues of mankind are divided. The family was also formerly called the Caucasian and the Japhetic family; but it is held by the more scientific grammarians of the present time, that the Aryan is the most appropriate technical term, inasmuch as Aryan was the name adopted by those colonists who left their ancient home in India to settle upon the shores of Europe. There are likewise two other great families of language, known respectively as the SEMITIC and the TURANIAN, both of which will be treated of in their proper place. To deal here with the Aryan languages:—The Aryan family of languages may, at the outset, be broadly classified into two great divisions; the Southern division, containing two great classes,—the Indic and Iranic. The Indic branch comprehends within itself, as living languages, the dialects of India and the dialect of the Gypsies; as dead languages, the Praikrit and Pali, the modern Sanskrit and the Vedic Sanskrit. The Iranic branch comprehends, as living languages, the dialects of Persia, Afghanistan, Kurdistan, Bokhara, Armenia, Ossethi; and as dead languages, the Parsi, Pehlvi, the cuneiform inscriptions of Darius and Xerxes, the Zend, and the old Armenian. The Northern division of the Aryan family of languages contains five chief classes. 1. The Celtic has two branches,—the Cymric and the Gadhelic. To the Cymric belong the dialects of Wales and Brittany, and the Cornish, the last being a dead language. To the Gadhelic branch of the Celtic class belong the dialects of Scotland, Ireland, and of the Isle of Man. 2. The Italic class embraces the dialects of Portugal, Spain, Provence, France, Italy, and Wallachia, as well as the dead languages known as the Langue d'oc, Langue d'oil, and the Oscan, Latin, and Umbrian. 3. The Illyric class contains the dialects of the Grisons and Albania. 4. The Hellenic class comprehends the dialects spoken in Greece at the present time, together with the Doric, Æolic, Attic, and Ionic, the four latter being dead languages. 5. The Windic class comprehends within itself the living dialects of Lithuania, Kurland, and Livonia (Lettish), as well as the old Prussian, which last is reckoned as a dead language; the living dialects of Belgium, Russia (Great, Little, and White), Illyria (Slovenian, Croatian, Servian), Poland, Bohemian (Slovakia), and Lusatia; in this class, also, are included the dead languages known as the Ecclesiastical Slavonic, the old Bohemian, and the Palabian. 6. The Teutonic class contains: the High German branch, in which are included the living dialects of Germany, and the dead languages, called the Middle High German and Old High German;—the Low German branch, containing the living dialects of England, Holland, Friesland, and the north of Germany (Platt Deutsch), together with the Gothic, Anglo-Saxon, old Dutch, old Frisian, and old Saxon, the five latter being dead languages;—the Scandinavian branch comprises the living dialects of Denmark, Sweden, Norway, and Iceland, as also the dead language known as the old Norse. It may be asked,—Why are these great streams of language, rolling on through centuries, set down as converging to one common source? To this question the greatest philologers of our day reply, that, in all these languages and dialects the common roots and the common organic type are deducible by means of a comparison and from a scrutiny of the laws of the human mind, of our organs of speech and of hearing, as well as of the laws of objects and phenomena. Yet, even if we attempt to assert that all the dialects of the Indo-Germanic family have diverged from one common type, how shall we able to prove this to be the original language? It might be the language of conquerors which had pushed away and survived numerous previous idioms. All that we can say is, that in the Aryan languages, the only field in which the scientific comparison of languages has as yet been successfully prosecuted, the closest affinity has been discovered in the roots and in the inflexions, those two chief tests of all inflecting languages. The great German philologers Bopp and Pott, together with their brilliant expounder Max Muller, show, by their general preference for Sanskrit, that they believe the Sanskrit form of the root to be the oldest in existence. That which gave to Sanskrit this high importance, was mainly the fact that the languages of Europe, whose relation to one another had either never been perceived or not thoroughly comprehended, stood at once in an intelligible relation to Sanskrit: the latter was the missing link that united them all. Even previous to the year 1794, the great orientalist Sir William Jones declared that no philosopher could examine the Sanskrit, Greek, and Latin, without believing them to have sprung from one common source; and, says Max Müller, "as sure as the six Roman dialects point to an original home of Italian shepherds on the seven hills at Rome, the Aryan languages together point to an earlier period of language, when the first ancestors of the Indians, the Persians, the Greeks, the Romans, the Slaves, the Celts, and the Germans, were living together within the same inclosures, nay, under the same roof." There was a time when a small clan of Aryans, dwelling probably on the highest elevation of Central Asia, and enjoying a high state of agricultural civilization, spoke a language which, although not Sanskrit, or German, or Greek, nevertheless contained the germs of the languages we employ to-day in our cathedrals, our courts of justice, and in our marts of commerce. And whatever may have been the name of this so-called mother of the Aryan languages, it can be demonstrated that she has distributed her property equally amongst all her children, without having granted the exclusive property to any; that the Greek, Roman, Celtic, Teutonic, and Slavonic colonies, marching towards the shores of Europe, brought away with them from their Asiatic birthplace the dialectic germs of their several languages, as we still hear them. Did space permit, an extensive list of examples in a tabular form might be given, to prove the unmistakable family likeness which exists between the chief representatives of the great Aryan family of languages. We must, however, be content with referring the reader to the list of valuable works appended to this article, wherein satisfactory

proof of the close affinity be . .m the . dialects, sprung from a common source, may be found. The Indo-Germanic family is the most important of the three great divisions of languages. By this is meant that the various modifications of time, person, number, gender, fact or potentiality, or degree of comparison, which may attach to the various notions of which speech is composed, are expressed by modifications of the notional words themselves, not by distinct words. It therefore accommodates itself to the nicest shade of meaning. Produced by the most gifted race in the most favourable area for human life and action, it has reciprocally aided in the development of that race above all others.—*Ref.* Sir Wm. Jones, in the *Asiatic Researches*; Fr. Schlegel's *Ueber die Sprache und Weisheit der Indier*; A. W. Schlegel's *Indische Bibliothek*; Bopp's *Comparative Grammar*; Grimm's *Deutsche Grammatik*; Pritchard on the *Eastern Origin of the Celtic Nations*; Zeus on the *Grammar of the Celtic Languages*; Max Müller's Lectures on the *Science of Language*; and generally the Proceedings and Transactions of the Philological Society of London.

INDORSER. (*See* BILL OF EXCHANGE.)

INDUCTION, *in-duk'-shun* (Lat. *inductio*), a method of philosophical and mathematical reasoning, but better known in the latter branch of science under the name of *successive induction*. As it collates truth from a demonstration, and this demonstration implies the examination of every particular case of which it is formed, it follows that the mathematical sense of the word is truly logical in its expression. The following examples are taken from the "English Cyclopædia." The sum of any number of successive odd numbers, beginning from unity, is a square number, namely, the square of half the even number which follows the last odd number. Let this proposition be true in any one single instance; that is, n being some whole number, let 1, 3, 5, up to $2n+1$, put together, give $(n+1)^2$; then the next odd number being $2n+3$, the sum of all the odd numbers up to $2n+3$ will be $(n+1)^2+2n+3$, or n^2+4n+4, or $(n+2)^2$. But $n+2$ is the half of the even number next following $2n+3$; consequently, if the proposition be true of any one set of odd numbers, it is true of one more. But it is true of the first odd number 1, for this is the square of half the even number next following; consequently, being true of 1 it is true of 1+3; being true of 1+3, it is true of 1+3+5; and so on *ad infinitum*. Next, the formula, x^n-a^n, n being a whole number, is always algebraically divisible by $x-a$

$$x^n-a^n=x^n-a^{n-1}x+a^{n-1}x-a^n$$
$$=x(x^{n-1}-a^{n-1})+a^{n-1}(x-a).$$

In this last expression the second term $a^{n-1}(x-a)$ is obviously divisible by $x-a$; if, then, $x^{n-1}-a^{n-1}$ be divisible by $x-a$, the whole of the second side of the last equation will be divisible by $x-a$; and therefore x^n-a^n will be divisible by $x-a$. If, then, any one of the successive—

$$x-a,\ x^2-a^2,\ x^3-a^3,\ x^4-a^4,\ \&c.$$

be divisible by $x-a$, so is the next. But this is obviously true of the first; therefore it is true of the second: being true of the second, it is true of the third; and so on *ad infinitum*. It will be readily seen by the reader from the foregoing examples, that hypothesis is one of the strongest proofs used in reasoning by induction.

INDUCTION COIL, a term applied originally to an apparatus, by which Faraday, in 1832, showed that an electric current, or a magnet, is able, by induction, to develop, at a distance, electric currents in a conducting wire; just as a body charged with static electricity electrizes an insulated conductor by induction. The method by which this remarkable result is obtained is as follows:—Two silk-covered wires are bound round a wooden cylinder, so as to make two perfectly similar helices, the spirals of which are parallel, and as near to each other as possible. The two ends of one of the wires are made to communicate with a delicate galvanometer, and the two ends of the other with the two poles of a voltaic pile. Whenever this latter communication is established, the first having been established previously, the needle of the galvanometer is seen to deviate; but this deviation immediately ceases, even though the current of the pile continues to circulate. As soon as the current is interrupted, the needle of the galvanometer experiences, a second time, a sudden and non-permanent deviation. This time, however, the deviation occurs in a contrary direction to that in which the former had occurred. The voltaic current that traverses one of the wires determines, in the other, an instantaneous current, at the moment when it commences to pass, and determines it in a second at the instant it ceases to pass. These two currents are called *induced currents*, and the current of the pile the *inducing current*. A similar experiment may also be made thus:—About a wooden or glass tube a single silk-covered wire is wound, and its two ends placed in communication with a galvanometer. Into the hollow of the tube is then inserted an electro-dynamic cylinder, namely, a helix, traversed by an electric current. At the moment of introduction, an induced current is shown in the outer coil, the movement of which is in a contrary direction to that passing through the inner helix; and upon withdrawing the cylinder, a second induced current is shown, the movement of which is in a direction similar to its own. These two experiments equally show that when a conductor traversed by a current is suddenly brought near to a conductor forming a closed circuit, an instantaneous current is determined in the latter, moving in a direction contrary to that of the current brought near it; and that, on removing it, a second current is determined, moving in the same direction as the current removed. On account of the analogy existing between the properties of magnets and those of electro-dynamic cylinders, Faraday supposed that the same results would be obtained by introducing a magnet into the interior of the hollow helix of the second experiment. His supposition proved correct. Two induced currents are instantaneously produced, which are much more intense than those produced by inducing currents. By these and similar means, very considerable effects can be produced. Experiment has also shown that the phenomenon of induction may be manifested with a single conductor, in which the inducing current is transmitted, and at the same time the induced current is perceived. When a soft iron rod is introduced into the helical coil, then, as observed by Mr. Jenkins, the volta-electrical effect becomes wonderfully increased. If the ends of the secondary coil are grasped through metallic cylinders, and contact made or broken with the battery, a smart shock is immediately felt through the animal frame, and is of such a nature as to be, with powerful arrangements of the apparatus, perfectly insupportable. Bright, vivid sparks can also be obtained from the secondary wire, and an amount of ordinary electricity developed quite unprecedented. In this modification of the induction-coil, the effects of electro-dynamic are combined with those of magno-electrical induction.

INDUCTION, ELECTRICAL. (*See* ELECTRICITY.)

INDUCTION, in Log. (*See* DEDUCTION.)

INDUCTIVE PHILOSOPHY, *in-duk'-tiv* (Lat. *in* and *duco*, I lead), that process of reasoning which raises individual cases into general, and those again into still higher generalities. Every deduction, properly so called, must rest on a prior induction. As . . . would necessitate an impossibility, for the particulars to be observed are infinite in number, it is necessary to allow some spontaneous action of the understanding in every inductive process. "'Two things,'" says Dr. Whewell, in his "History of the Inductive Sciences," "are requisite to the formation of science, facts, and ideas,—observation of things *without*, and *inward* effort of thought; or, in other words, sense and reason. Neither of these elements by itself can constitute substantial general knowledge." It is easy to point out how a defect in this mental process has at different times retarded the advancement of science; indeed, in by far the greater part of the course of the world, the history of most times and countries, exhibits a condition thus stationary with regard to knowledge. Many facts in physical science, such as the motions of the stars and the weights of bodies, were familiar to man long before the rise of Greek astronomy and mechanics. What was wanted was the act of thought. At the present day even, tribes of uncivilized and half-civilised men, over the surface of the earth, have before them the immense

body of facts, out of which the civilised world has erected the stately fabric of physical philosophy. Yet, except among European nations, the process of intellect by which these *facts* became science seems to have been unknown. Almost every part of the career of the Greek schools of philosophy, of the schoolmen of Europe in the middle ages, of the Arabian and Indian philosophers, shows, that extreme ingenuity and subtlety, invention and connection, demonstration and method, may exist, without the development of any physical science. Logic and metaphysics, and even geometry and algebra, may be obtained by such means, but never mechanics and optics, chemistry and physiology.—*Ref.* Whewell's *History of Ideas*; and *Novum Organon renovatum.*

INDULGENCE, *in-dul'-jens* (Lat.), is the remission of the penalty due for sin, either in this world or in purgatory, a power claimed by the Roman Catholic church. Indulgences were first introduced in the 11th century, by Urban II., as a recompense to those who engaged upon the Crusades. They were afterwards granted to those who gave money for the purpose; and hence was introduced the sale of them; and at length every sin came to have its price. The sale of indulgences was one of the causes that led to the Reformation.

INDUS, *in'-dus* (Lat. *indus*, an Indian), a constellation of the southern hemisphere. It lies to the south of Sagittarius, being between that constellation and the south pole. It was formed and named by Bayer. Its largest star is one of the third magnitude.

INEQUALITIES, *in-e-kwol'-e-tees* (Lat. *inæqualitas*, difference, or want of equality), in Math., a term used in algebra to express that one quantity is greater or less than another, or than nothing, when it is termed an *inequality*. Thus, the expression $x-a \mathbin{7} b-x$ is an *inequality*, of which $x-a$ forms one *side* and $b-x$ the other. One of the strongest propositions of this rule is, that any quantity may be added to, or subtracted from, each side of an inequality, and yet the sign of inequality will remain as before. Thus, if $a \mathbin{7} b$, it may be consequently assumed that $a\pm x \mathbin{7} b\pm x$; for if $a \mathbin{7} b$, it is evident that $a+x \mathbin{7} b+x$. And similarly, if $a \angle b$, it follows that $a+x \angle b+x$. Hence any quantity may be transposed (as in equations) from one side of an inequality to the other by changing its sign; thus, if

$$a^2+b^2 \mathbin{7} 2ab+c^2$$
$$a^2+b^2-2ab \mathbin{7} 2ab-2ab+c^2$$
$$\text{or, } (a-b)^2 \mathbin{7} c^2.$$

Also, in a series, if $a \mathbin{7} b$, $c \mathbin{7} d$, and $e \mathbin{7} f$, &c., then $a+c+e+$ &c. $\mathbin{7} b+d+f+$ &c.

Also, if every term on each side of an inequality be multiplied or divided by any positive quantity, the sign of inequality will remain as before; thus, if $a \mathbin{7} b$, it follows that $2a \mathbin{7} 2b$, &c. Both sides of an inequality may be raised to any power, or any root of them be extended, and the sign of inequality will remain as before, provided each side be a positive quantity, $7 \mathbin{7} 5$, or $7^2 \mathbin{7} 5^2$; and so on.—*Ref.* Wood's *Algebra.*

INERTIA, *in-er'-she-à* (Lat.), is that property of matter by which it would always continue in the same state of rest or motion in which it was put, unless changed by some external force. Kepler conceived this as indicating a degree of power, and termed it *vis inertiæ*. "The *vis insita* (*vis inertiæ*), or innate force of matter," says Newton, "is a power of resisting by which every body, as much as in it lies, endeavours to persevere in its present state, whether it be of rest or of moving uniformly forward in a straight line. This force is ever proportional to the body whose force it is; and differs nothing from the activity of the mass but in our manner of conceiving it." A body, from the inactivity of matter, is not without difficulty put out of its state of rest or motion. Upon this account, this *vis insita* may, by a most significant name, be called *vis inertiæ*, or, force of inactivity."—(*Princip.*, def. 3.) In conclusion, it may be said that *inertia* is the principal law of the material world, that all bodies are absolutely passive, or indifferent to a state of rest, and would continue for ever so unless disturbed by the action of some extrinsic force. Inertia itself is one of the inherent properties of matter, and is unceasingly recalled to our notice in every incident of life. (*See* GRAVITATION.)

IN ESSE, *in es'-se* (Lat., in being), in Phil., is a term applied to things actually existing; and is distinguished from *in posse*, applied to things which are not, but which might be.

INFAMY, *in'-fâm-e* (Lat. *infamia*), is defined to be "a permanent legal incapacity to which a man is subjected in consequence of a conviction and judgment for an offence, and which is not removed by suffering the punishment for the offence." Among the Romans, the consequence of infamia was incapacity to obtain the honours of the state, with the loss of political rights, and also of certain private ones. Persons who, in consequence of bribery, &c., are deprived of their right of voting at elections, are infamous, having lost part of their political rights. Certain offences were formerly considered of so heinous a nature as to render a man infamous and incompetent to be a witness. The endurance of the punishment, however, restored the man's competency as a witness. Act 6 & 7 Vict. c. 85, however, declares that no person offered as a witness is to be excluded on account of incapacity from crime, though such may be urged as an argument against his credibility.—Ref. *English Cyclopædia,*—Arts and Sciences.

INFANT, *in'-fânt* (Lat. *infans*), in Law, is a person under twenty-one years of age. In general, an infant can neither aliene his lands, nor do any legal act, nor make a deed, nor indeed any manner of contract that will bind him; but to these rules there are some exceptions. Infants have thus various privileges and various disabilities; but their very disabilities are privileges, in order to secure them from hurting themselves by their own improvident acts. An infant, when sued, appears to defend his cause by a guardian; but he may sue, either by his guardian or *prochein amy*, his next friend, who is not his guardian. In criminal cases, an infant of the age of fourteen years may be capitally punished for any capital offence; but under seven years he cannot. The period between seven and fourteen is subject to much uncertainty; for the infant is, generally speaking, judged to be *primâ facie* innocent; yet, if he be *doli capax*, and could discern between good and evil at the time of the offence committed, he may be convicted, and undergo judgment and execution of death, though he has not attained to years of discretion.

INFANT SCHOOLS (*See* SCHOOLS.)

INFANTA, *in-fant'-a* (Sp.), a word signifying child, and generally applied as a title of honour to the princesses of the royal houses of Spain and Portugal. The pre-eminence implied by the appellation may be seen by infanta, signifying *the* child *par excellence*.

INFANTICIDE, or CHILD-MURDER, *in-fănt'-e-side*, has been practised from very early times. Among certain of the Greek states, it was the practice to expose or destroy weak or deformed children. In Rome also it was common to expose or put to death children. In the present day, the Chinese are chiefly notorious for the extent to which they practise this crime; but in the islands of the Pacific, in some parts of India, in Africa, and South America, it is by no means uncommon. Unfortunately, however, the practice is not confined to heathen countries, but prevails to a considerable extent even in our own, notwithstanding the deep abhorrence with which it is viewed, and the severity with which it is punished. One of the most difficult questions of medical jurisprudence is to ascertain the murder of a child newly born. It has first to be determined whether the child was born dead or alive, and next, whether its death was occasioned by violence, or was the result of natural causes. If it be proved that the child was born alive, and subsequently destroyed, either by violence or wilful neglect, the offence is murder, and punishable accordingly.

INFANTRY, *in'-fân-tre* (Lat. *infans*, a child; Ital. *fante*, a child, or young person), a name that is applied to all soldiers who serve on foot, in contradistinction to horse-soldiers, or cavalry, who serve on horseback. In the feudal times, the retainers of the nobles and large land-owners were bound to render suit and service to their feudal lord in time of war, as the nobles themselves were under an obligation to aid the king under the same circumstances, in virtue of the peculiar tenure on which they held their lands. In return for this, their dependents were entitled to protection from

wrong and injury at the hands of others; and as the relationship between the feudal superior on the one side, and his vassals on the other, was somewhat analogous to that which exists between a father and his children, the men that were supplied as a contingent to the king's [illegible] were always [illegible] reason, the word "infantry," under various modifications, according to the language of different countries, is now the recognized appellation of the foot-soldiers of every nation. The infantry formed the most important part of the armies of the Greeks and Romans. The northern nations of Europe also fought on foot, and the principal part of the English troops, from the establishment of the Saxon heptarchy to the time of the Conquest, consisted of infantry. It was not until chivalry had become a prominent institution in all European countries, that infantry fell into disrepute. It was, indeed, impossible that it should be otherwise; for while the cavalry was completely armed and disciplined, but little attention was paid to the equipment of the foot-soldiers of the middle ages, whose want of organization too often rendered them comparatively useless. The English infantry has always sustained its renown. Both before and after the Conquest, the foot-soldiers of England were armed with pikes, battle-axes, long knives, or "whittles," and swords, and furnished with iron helmets, and wadded tunics or coats of thick leather, as defensive armour. The service rendered by the archers of England in the wars of Edward III. and Henry V., in France, are too well known to require mention here, and the superiority of the English infantry over the foot-soldiers of the continental powers at that time, who seem to have borne the very worst of characters, the Swiss alone excepted, is clearly demonstrated by the accounts of the battles of Cressy, Poitiers, and Agincourt. The infantry began to regain their old reputation after the introduction of fire-arms; and the glorious deeds of the Scottish archers, pikemen, and musketeers, in France, Sweden, Denmark, Germany, and the Low Countries in the 16th and 17th centuries, form many a brilliant page in the history of Europe. It was not until the latter part of the 17th century, that regiments of infantry were embodied in England, to form part of a standing army in the service of the Crown. (*See* HOUSEHOLD TROOPS.) Of these, the oldest are the 1st Royal regiment of foot, familiarly styled the 1st Royals, and the 3rd Buffs. The discipline and organization of infantry have been brought to the highest degree of perfection of late years, and, as far as arms are concerned, the introduction of the rifled musket leaves room for little, if any, improvement.

INFECTION, *in-fek'-shun* (Lat.), in Med., is the propagation of disease by means of deleterious or offensive effluvia contained in the atmosphere. The offensive matter may either proceed from the decomposition of animal or vegetable substances, or may emanate from the bodies of persons affected by particular diseases. The presence of some of these agents may be recognized by the smell, of others only by their mischievous effects. The most important means of disinfection is ventilation. Various chemical agents are also employed for this purpose; as chlorine, chloride of zinc, perchloride of iron, sulphurous acid, &c.

INFEOFFMENT, *in-fe'-of-ment*, in the Law of Scotland, denotes the manner in which a person is invested in any real or heritable property. Until very recently, the form was for several persons to proceed to the ground, when earth and stone thereof were handed to him who represented the new possessor. The transaction was attested by a notary, in a deed called an instrument of sasine, which had to be recorded, within sixty days after the ceremony, in the Register of Sasines. This ceremony is now done away with, and only the registration of the deeds required.

INFERNAL MACHINE, *in-fer'-nŭl* (Fr., from Lat. *infernus*), a name given generally to all machines containing powder and projectiles, and destined to destroy human life. Infernal machines are often employed in war, being commonly placed under water and fired by means of electricity; thus often causing great damage to a hostile fleet, if the presence of the machine be not perceived in time. The name *infernal machine*, however, applies more particularly to those made use of in conspiracies and political plots, as the one tried against Napoleon Buonaparte in 1800, against Louis Philippe in 1835, and against Louis Napoleon on the 14th January, 1858, none of which were successful, the conspirators in each case meeting with the punishment their attempts at murder deserved.

INFIDEL, *in'-fi-del* (Lat. *infidelis*, unbelieving), is one who does not believe the truth of the Christian religion. (*See* CHRISTIANITY, ATHEISM, DEISM.)

INFINITE, *in'-fin-it* (Lat. *in* and *finitum*, unlimited, boundless), in Phil., denotes the entire absence of all limits or bounds; and is applicable to the one infinite Being in all his attributes. As to our idea of the infinite, two opposite opinions exist among philosophers. According to some, the idea is purely negative, without anything positive in it, except what may be furnished by the imagination, which goes on enlarging the finite without limit. According to others, the enlarging of the finite can never furnish the idea of the infinite, but only of the indefinite. "We must," says Sir W. Hamilton, "believe in the infinity of God; but the infinite God cannot by us, in the present limitation of our faculties, be comprehended or conceived. A deity understood would be no deity at all; and it is blasphemy to say that God only is as we are able to think him to be. We know God according to the finitude of our faculties; the infinite God is, to use the words of Pascal, infinitely inconceivable." The Scriptures indeed declare that now we know only in part.

INFINITY, INFINITESIMAL. (*See* INTEGRAL CALCULUS.)

INFINITIVE MOOD, *in-fin'-i-tiv* (Lat. *infinitivus*), in Gram., is that form or state of the verb which expresses a thing in a general manner, without any distinction of number or person; as, to walk, to speak, to be feared.

INFIRMARY, *in-fir'-mă-re* (Lat. *infirmus*, infirm), is an hospital for the reception and medical treatment of the sick poor. Fortunately, in almost all of the considerable towns of this country, there are now establishments of this description, supported either by public subscriptions or by private endowments. (*See* HOSPITAL.)

INFLAMMATION, *in-flăm-mai'-shun* (Lat. *inflammatio*, from *inflammo*, I burn), in Pathol., is a preternaturally hot, red, swollen, and painful condition of any portion of the body: when the inflammation is general, it takes the form of fever. It is usually distinguished by a particular name, according to the part which is attacked; as *pleuritis*, inflammation of the pleura; *peritonitis*, of the peritoneum; *gastritis*, of the stomach; *hepatitis*, of the liver, &c. Inflammations may be produced by various causes,—by external injury, as a cut, bruise, or burn; by the action of some chemical or other agent, as poisons, alcoholic liquors; or from exposure to cold, wet, &c. Inflammation may be acute or chronic; diffuse or circumscribed; healthy, with a disposition to heal and return to the natural state, or unhealthy, when, on the contrary, there is a disposition to ulceration, &c. It may terminate in one of three ways,—in resolution, in suppuration, in mortification. The first of these is the most desirable mode of termination, being the gradual subsidence of the inflammatory action, and the return of the parts to their natural state, without any visible morbid change in their structure. In suppuration, the inflammation goes on to the formation of pus, when the swelling increases in size, becomes more red and shining, then grows soft in the centre, and at length the matter makes its escape either through a natural or an artificial opening. The most dangerous termination is in mortification, which is caused by the inflammatory action being too violent for the vital process of the part. The pain is at first very severe, then the bright red colour of the part becomes livid, vesicles form on the surface, the pain abates, and the death of the part ensues. The immediate cause of inflammation is believed to be the exudation of the liquor sanguinis through the softened or ruptured walls of the capillary vessels of the part, in consequence of an increased flow of blood there. The mode of treatment in inflammation will of course vary according to the seat and character of the general symptoms. Commonly, when the patient is strong and of a full habit, general bleeding is recommended. Local

bleeding, by means of cupping, leeches, &c., should also be had recourse to. A low diet, purgative medicines, cooling drinks, diaphoretics, and the avoidance of all excitement, are also necessary. Dr. Hughes Bennett, of Edinburgh, however, maintains that the abstraction of blood does not exert any beneficial effect upon the inflammatory state, and that its influence on the system is injurious; and hence he condemns its being resorted to for the sake of the inflammation. This, however, is not the generally received opinion among medical men. (*See* PLEURITIS, PERITONITIS, &c.)

INFLECTION, or INFLEXION, *in-flek'-shun* (Lat. *inflecto*, I bend), in Gram., means any change which takes place in a word, from a modification of its sense between the *root* and the *termination*. The inflexion must therefore not be confounded with the termination itself. For example, the syllable *am* is the root of all the words employed in the conjugation of the Latin verb *amo*, 'I love;' in the imperfect tense the inflexion is the syllable *ab*. The termination varies according to the person: *amabam, amabas, amabat.* — *Ref.* Brande's *Dictionary*.

INFLEXION, in Optics, is synonymous with the term diffraction, or that property of light by reason of which, when it passes very near the borders of an opaque body, it is turned from its rectilinear course. (*See* LIGHT.)

INFLEXION, POINT OF, in Geom., is that point of a curve line where the curvature in relation to the axis changes from concave to convex, or from convex to concave. To find the point of inflexion in a given curve, it is only necessary to find, from the equation of the curve, the value of $\frac{d^2y}{dx^2}$: this value made equal to O, or infinity, will give an equation by which x can be determined. In the above equation, d^2y stands for the second differential. (*See* INTEGRAL CALCULUS.)

INFLORESCENCE, or ANTHOTAXIS, *in-flor-es'-ens an-tho-tak'-sis* (Lat. *inflorescens*; Gr. *anthos*, flower; *taxis*, a placing), in Bot., a term applied to the arrangement of the flowers on the axis, or to the ramification of the floral axis. The forms under which the flower-stalk is presented to our notice are described under PEDUNCLE; and many particulars relating to inflorescence are noted under BRACT. In describing the principal forms of inflorescence, we shall follow Professor Bentley, to whose excellent Manual we refer the student for full details. Flowers are variously arranged upon the floral axis, and to each arrangement a particular name is applied. These modifications are always the same for the same species of plant, and frequently throughout entire genera, and even natural orders; and hence their discrimination is of great practical importance. All the regular forms may be arranged in two great classes, the principles of which being understood, their subordinate modifications will be readily intelligible.

Class I. *Indefinite, Indeterminate, or Axillary Inflorescence.*—The primary floral axis is terminated by a growing point analogous to the terminal leaf-bud of a stem or branch; it has consequently the power of growing or elongating in an upward direction, or of dilating more or less horizontally, there being no necessary limit to its growth. Such an axis, as it continues to grow upwards, develops on its sides other buds, from which flowers are produced. The general characters of the inflorescence in this class depend, therefore, upon the indefinite growth of the primary axis; while the secondary, tertiary, or other axes which are developed from it, are terminated by flower-buds. The simplest kind of indefinite inflorescence is that presented by such plants as the pimpernel and moneywort, in which solitary flowers are developed in the axils of the ordi-

solitary and *axillary*. When such flowers are arranged in whorls round the stem, each flower being axillary to a leaf, as in the common mare's-tail, they are said to be whorled. When a number of flowers are deve-
, instead of a single one, upon an elongated or
sed axis which is placed at the extremity of a
h or in the axil of a bract, a number of kinds of
e arise, depending upon the extent to which the axis is divided, the mode in which the branching takes place, the comparative length of the flower-stalks, and other subordinate circumstances. These modifications are arranged by Professor Bentley under two heads:—1. Those with an elongated primary axis; and, 2. those with a shortened or dilated primary axis.

1. *Kinds of Indefinite Inflorescence with an elongated primary axis.*—These are as follows:—

The spike.—An elongated axis, simply bearing sessile flowers, or flowers in which the pedicels are too short to be clearly distinguishable. Examples may be seen in the rib-grass and vervain. In this kind of inflorescence the flowers at the base open first, and those at the apex last. This mode of opening is called *centripetal*; it is universal in the different kinds of indefinite inflorescence, which in all cases open from the base to the apex, if the axis is elongated, or from the circumference towards the centre, if it is depressed or dilate.

CATKIN.

The amentum, or catkin.—A kind of spike, bearing only barren flowers,—that is, only stamens or pistils. These are separated from each other by squamous bracts, and the whole inflorescence usually falls off in one piece soon after flowering or fruiting. Examples are furnished by the hazel, willow, birch, poplar, &c.

The Spadix.—A spike with a succulent axis, in which the individual flowers have no bracts, but the whole inflorescence is inclosed in a long bract called a spathe. The common arum, or cuckoo-pint, affords an excellent example.

The Locusta, or Spikelet.—The partial inflorescence of a grass or cyperaceous plant, consisting of a spike with a few flowers, which are destitute of calyx and corolla, but have, in place of those envelopes, membranous bracts called *paleæ*: the whole inflorescence is surrounded at the base by one or two empty bracts called *glumes*. The spikelets may be either arranged sessile on the primary axis, as in wheat, or placed on a more or less branched axis, as in the oat.

The Cone.—The kind of spike found in coniferous plants, as the pine, fir, larch, &c. It is composed of female flowers, each of which has at its base a persistent woody scale or bract.

The Strobilus, or Strobile, a kind of spike with

RACEME.

THYRSUS.

female flowers, each of which has a membranous bract or scale at its base. It is seen in the hop.

The Raceme.—In this kind of inflorescence, the pri-

mary axis is elongated, and bears flowers placed [illegible] pedicels of nearly equal length. It differs from the spike only in the flowers being stalked instead of sessile. Examples occur in the currant, mignonette, hyacinth, laburn[illegible] &c.

The Corymb.—In [illegible], or flower-stalks, are of different lengths, those at the base of th[e] primary axis being longer than those towards and at the apex, so that all the flowers are nearly level. I[t] occurs in the hawthorn, &c. When the stalks of [the] corymb divide, instead of bearing flowers immediately, as in some species of pyrus, a *branching* or *compou[nd]* corymb is formed.

The Panicle, a modification of the raceme, produced by the subdivision of the secondary axes. Instead o[f] producing flowers directly, those axes branch int[o] tertiary ones, which bear the flowers. The inflorescence of the *Yucca gloriosa*, and the general arrangement of the spikelets of the oat, are examples.

The Thyrsus, or Thyrse, a kind of panicle, in whic[h] the pedicels are generally very short, and the whole a[re] arranged as to form a compact cluster of blossoms. Examples may be found in the grape-vine, horse-chestnut, and lilac.

2. *Kinds of Indefinite Inflorescence with a shortene[d] or dilated primary axis.*—The principal are the following:—

The Capitulum, Anthodium, or Head.—This kind o[f] inflorescence constitutes the *compound flower* of Linnæus. It is formed by a number of sessile flower[s] crowded togethe[r] on a receptacle, the whole bein[g] surrounded by an involucre. The heads of flowers take a variety o[f] forms dependen[t] upon the shape of the receptacle, which may be flattened, slightly convex, conical, or globular. In this kind of inflorescence the centripetal order of expansion is often very evident, the outer florets being fully expanded, those within them partially opened, and those in the centre in an unopened condition. Examples are seen in the cotton thistle, dandelion, chamomile, American button-bush, &c.

CAPITULUM.

The Hypanthodium, a slight modification of the last, formed by a receptacle, which is usually of a fleshy nature, becoming more or less incurved, and thus partially (as i[n] the Dorstenia), or entirely (as i[n] the fig), inclosing the flowers which it bears on its surface.

The Umbel.—In this, the primary axis is shortened, and gives off from its apex a number of secondary axes, or pedicels, of nearly equal length, each bearing a flower, and arranged like the ribs of an umbrella. Examples of the simple umbel are seen in the primrose, cowslip, &c. When the secondary axes divide, and form tertiary axes, which are also arranged in an umbellate manner, a *compound umbel* is produced. This is seen in the carrot, fennel, fool's parsley, hemlock, and other allied plants, which are hence called *umbelliferous*.

UMBEL.

Class II. *Definite Determinate, or Terminal Inflorescence.* — In this class of inflorescence, the primary axis is arrested in its growth, at an early age, by the development of a terminal flower-bud; and if the axis bears no other flowers, this is called a *solitary terminal* flower, and is the simplest form of definite inflorescence. It may be seen in the stemless gentian, the wood anemone, &c. When other flowers are produced on such an axis, they must necessarily arise from axillary buds placed below the terminal flower-bud, and if these form secondary axes, they will, in like manner, be arrested in their growth by a terminal flower-bud; hence this mode of inflorescence is *definite*, in contradistinction to the former, or indefinite inflorescence, where the primary axis elongates indefinitely, unless stopped by some extraneous cause. In definite inflorescences, the order of unfolding in the flower-buds is from the apex to the base, if the axis be elongated, or from the centre to the circumference, if the axis be depressed or dilated. Such an order of expansion is termed *centrifugal*. The general name of *cyme* is applied to all inflorescences of this class; but it is customary to distinguish a few by special names, as follows:—

The True Cyme.—A definite inflorescence, more or less branched, the whole being developed in a corymbose manner. It assumes the form of a somewhat flattened head in the laurustinus and elder, of a rounded mass of blossoms in the hydrangea, and of a more diffuse bunch in the chickweed. By attention to the centrifugal order of expansion, such cymes may be always distinguished from the umbel, corymb, or other indefinite kinds of inflorescence, to which, otherwise, they bear in many cases a great resemblance.

The Spiked Cyme.—A definite inflorescence, formed of sessile flowers, and bearing a resemblance to the spike. Example, the inflorescence of the sedum, or stone-crop.

The Racemose Cyme.—A cyme having flowers on pedicels of nearly equal length, as in the campanula.

CYME.

The Panicled Cyme.—This is a definite inflorescence, resembling in appearance the panicle. The privet affords a good example.

The Helicoid, or Scorpioid Cyme.—This kind of cyme [ha]s flowers only upon one side, and its upper extremity [i]s more or less coiled up in a circinate manner, so as frequently to resemble a snail, or the tail of a scorpion. These cymes are especially developed in the nat. ord. *Boraginaceæ*, as in the forget-me-not. It is extremely difficult to distinguish this kind of inflorescence from the raceme, as the order of expansion *appears* to be *centripetal*.

The Fascicle, or Contracted Cyme.—In this, the flowers [ar]e placed on short pedicels, of nearly equal length, and consequently crowded together. It is seen in the sweet-william.

The Glomerule.—A cyme consisting of a number of sessile flowers, or flowers with very short pedicels, collected into a rounded head or short spike. It bears nearly the same relation to the true cyme as the capitulum does to the umbel. It is seen in species of nettle, and in the box.

The Verticillaster.—This kind of cyme is seen in the white dead nettle, and other plants of the labiate tribe. In it the flowers appear at first sight to be arranged in a whorl round the stem, but upon examination, it will be readily seen that there are two clusters axillary to the opposite leaves, the central flowers of which open first, proving the mode of expansion to be centrifugal. To each of these clusters the name of *verticillaster* is applied.

Examples of *Mixed Inflorescence* are by no means uncommon. Thus, in plants of the nat. ord. *Compositæ*, the terminal capitulum is the first to expand, and the capitula, as a whole, are therefore developed in a centrifugal manner; the individual capitula, however, open their small flowers or florets centripetally; hence, here, the general inflorescence is definite, and the partial inflorescence indefinite.

INFLUENZA, *in-flu-en'-za* (Ital., influence; so called because it was believed to be produced by the influence of the stars), in Med., is an epidemic febrile catarrh, differing from a common catarrh in the greater severity of its symptoms. It comes on sud-

denly, attacking many persons at once; but though the symptoms are alarming, it is seldom fatal, except to the aged, or those of weakly constitution. The person is first seized with slight chills; there is great heaviness and pain over the eyes, great prostration of strength, loss of appetite, quick, irregular pulse, cough and difficulty of breathing, with running at the nose and eyes. The duration of the disease varies from two or three days to as many weeks; and frequently the debility continues much longer, occasioning, not uncommonly, relapses. Differences of opinion exist as to the immediate cause of this disease, some attributing it to a noxious principle existing in the atmosphere, others to sudden changes of the weather, &c.; but nothing is definitely known on the subject. In its treatment, little is required to be done beyond keeping the patient in bed, in a warm and agreeable temperature, and the administration of aperient and cooling medicines. When the difficulty of breathing is considerable, mustard poultices may be applied to the chest. When the fever has subsided, tonics and stimulants should be employed; and should the cough remain obstinate, change of air will generally be found to be the most effectual means of removing it.

INFORMATION, *in-for-mai'-shun* (Lat. *informatio*), in Law, is an accusation, or complaint, against a defendant for some criminal offence. Informations are of two sorts: first, such as are partly at the suit of the crown and partly at that of a subject; and, second, such as are in the name of the crown only. The latter are of two kinds,—those that are truly and properly her majesty's own suits, and filed by her own immediate officer, the attorney-general, and those in which, though the queen is nominal prosecutor, yet it is at the relation of some private person, or common informer, and they are filed by the queen's coroner and the attorney in the court of Queen's Bench. The former are for such enormous misdemeanours as peculiarly tend to disturb or endanger her government, or to molest or affront her in the discharge of her royal functions; the latter, any gross and notorious misdemeanours, riots, &c., not particularly tending to disturb the government, but yet deserving public animadversion.

IN FORMÂ PAUPERIS. (*See* FORMÂ PAUPERIS.)

INFUSION, *in-fu'-zhun* (Lat. *infusio*, a pouring in or upon, a steeping; Fr. *infuser*, to infuse), a solution of some of the principles of vegetables, generally in water, but sometimes in other vehicles. Either hot or cold water may be employed, according to the particular infusion required. The digestion, however, must be longer when cold water is used. The vegetable substances may be either fresh or dried; when fresh, they must be cut in pieces, and when dry, bruised or coarsely powdered. Water is then poured on the substance employed, and allowed to stand in a covered vessel for a space of time varying with the nature of the vegetable matter. It is afterwards strained, and is then fit for use. Infusions are liable to spoil soon, especially when made with warm water, or if the substance be of a fermentable nature. To assist in keeping the infusion, or to increase its powers, alcohol is sometimes added after straining. Wholesale chemists are now accustomed to prepare concentrated infusions for the use of general practitioners. These can be diluted to the ordinary strength at the time of using them, and not only possess the advantage of keeping better, but save much trouble and loss of time. Infusions are also made by percolation, or, as it is termed by the French, *par déplacement*.

INFUSORIA, *in-fu-so'-re-ă* (Lat. *infundo*, I pour in), a class of very minute animalcules inhabiting stagnant water, fresh or salt, in which plants are growing, or in which an abundance of decayed animal or vegetable matter is contained. The invention of the microscope revealed the existence of myriads of living creatures whose presence, up to that time, was unsuspected; and by its means we are able to perceive that a drop of water, though apparently perfectly clear to the naked eye, is really swarming with living beings. [illegible]s have been described from [illegible]th to [illegible]th of a line in length. They are, indeed, so extremely minute in size, that it is calculated that a moderate-sized drop of water may contain 500,000,000 of them. The infusoria are of very simple organization, as they have neither vessels nor nerves, are not symmetrical, have not distinct sexes, have no visible eggs, and are without determined or apparent digestive cavities. Their chief organs seem to be internal spherical cavities, frequently containing foreign particles derived from the surrounding water, and supposed to serve as food. Some of them have no apparent locomotive organs; others have either cilia, or changeable processes, as they are called,—expansions of the substance of the body. In most cases the substance of the bodies of infusoria consists of a glutinous, homogeneous, or slightly granular, transparent mass. Red specks resembling eyes have been observed in some varieties, and by many zoologists they are so considered; while others deny it, on account of the absence of any nervous system and no appearance of any cornea or lens. The food of infusoria consists of decomposing vegetable and animal matter, and they frequently devour each other. They are the prey of other aquatic animals, and, as soon as they accumulate in large quantities, contribute largely to the nourishment of more highly organized beings which are useful to man. This has been particularly observed in cold climates, where vegetable life ceases to exist in the ocean. Infusoria are found to exist in these latitudes in inconceivable numbers, and form the principal nourishment of the fishes inhabiting those parts. Their mode of propagation is very remarkable: it consists in spontaneous division, which is either longitudinal or transverse; in gemmation, the buds arising from the posterior part of the body; in the incysted process, cysts forming, which, when they burst, liberate animalcules which do not resemble their parent in form; and also in alternation of generations. (*See* GENERATIONS, ALTERNATION OF.) Infusoria frequently occur in such large numbers as to colour large tracts of water. Some of these impart a blood-red hue to the water, others a blue colour; while others tinge the surface with green. They can resist a temperature of 24° below freezing-point, and a degree of heat equal to 200°. Ehrenberg, whose labours have principally contributed to the knowledge of the nature and structure of the infusoria, has divided them into two large groups,—*Polygastrica* and *Rotifera*. The latter family, however, has lately been proved to be of a much higher organization than the former, and has consequently been removed into a separate class away from the infusoria. The Polygastrica have also been shown to contain several families which are not true infusoria. Among these may be mentioned the Diatomaceæ, which have been proved to be varieties of algæ. (*See* DIATOMACEÆ.) The greater portion of the fossil infusoria described by naturalists has also been removed to the Diatomaceæ.—*Ref.* Ehrenberg's *Die Infusionsthierchen*; *Memoirs of the Berlin Academy*, and translations in Taylor's *Scientific Memoirs*; Mantell's *Medals of Creation and Annals of Natural History*.

INGOT, *in'-got* (Fr. *lingot*), a word of rather doubtful derivation, signifying the small masses or bars of gold and silver intended either for coinage or importation.

INGUINAL. (*See* GROIN.)

INHERITANCE, *in-her'-e-tans* (from Lat. *hæres*, an heir), a term applied, in Law, to a perpetual or continuing right to an estate invested in a person and his heirs. The *canons of inheritance* by which it was governed, directed the descent of real property throughout the lineal and collateral consanguinity of the owner, dying intestate, who is technically called the purchaser. These canons were materially altered by 3 & 4 Will. IV. c. 106. (*See* DESCENT.) The new and revised canons are as follows:—(1) That inheritances shall lineally descend to the issue of the person who last died entitled, *in infinitum*; (2) that the male issue shall be admitted before the female; (3) that where there are two or more males in equal degree, the eldest only shall inherit, but the females altogether; (4) that the lineal descendants, *in infinitum*, of any person deceased, shall represent their ancestor,—that is, shall stand in the same place as the person himself would have done had he been living; (5) that on failure of lineal descendants, or issue of the person last entitled, the inheritance shall ascend and descend to the lineal ancestors, and to the collateral relatives of the purchaser; (6) that the nearest lineal ancestor shall be the heir of the purchaser, in preference to

any of the descendants of such lineal ancestor, and more remote lineal ancestors and their descendants (other than himself); and the descendants of every such lineal ancestor shall succeed next after, or in default of him; so that the father shall be preferred to a brother or sister, and a more remote lineal ancestor to any of his issue, other than a nearer lineal ancestor or his issue; and subject to this rule and to the next, the descent to collaterals shall be subject to the second, third, and fourth canons; (7) that, as between collaterals of a purchaser, a relation of the half-blood shall succeed next after any relation in the same degree of the whole blood and his issue, where the common ancestor shall be a male, and next after the common ancestor, where such common ancestor shall be a female. So that the brother of the half-blood on the part of the father, shall inherit next after the sisters of the whole blood on the part of the father and their issue; and the brother of the half-blood on the part of the mother shall inherit next after the mother. The collaterals of the half-blood of a person last entitled, who was not a purchaser, will take in course of descent from the purchaser of whose whole blood they are, by force of the direction, that in every case the descent shall be traced from the purchaser. (8) That in lineal ascending, and in collateral inheritances, the male stock shall be preferred to the female (that is, the male ancestors and kindred derived from the blood, however remote, shall be admitted before female ancestors and kindred derived from their blood, however near), unless where the lands have in fact descended from a female. Therefore, under the new law, none of the maternal ancestors of the person from whom the descent is to be traced (viz. the purchaser), nor any of their descendants, are capable of inheriting, until all his paternal ancestors and their descendants shall have failed; and also no female paternal ancestor of such person, nor any of her descendants, is, or are, capable of inheriting, until all his male paternal ancestors and their descendants shall have failed; and no female maternal ancestor of such person, nor any of her descendants, is, or are, capable of inheriting until all his male maternal ancestors and their descendants have failed. (9) When there shall be a total failure of heirs of the purchaser, or where any lands shall be descendible, as if an ancestor had been the purchaser thereof, and there shall be a total failure of the heirs of such ancestor, then, and in every such case, the land shall descend, and the descent shall thenceforth be traced from the person last entitled to the land, as if he had been the purchaser thereof (22 & 23 Vict. c. 35, s. 19). This enactment is to be read as part of the 3 & 4 Will. IV. c. 106, s. 20. (*See* also 2 Sug. V. & P. 238, 10th edition.)—*Ref.* Wharton's *Law Lexicon*.

INJECTION, *in-jek'-shun* (Lat. *inficio*, I cast in), in Med., is a medicated liquor thrown into some cavity of the body by means of a syringe or other apparatus. (*See* CLYSTER.)

INJUNCTION, *in-junk'-shun* (Lat. *injunctio*), in Law, is a writ which issues under the seal of a court of equity, in order to restrain proceedings in other courts, &c. Injunctions are usually divided into common and special, the former being granted to restrain proceedings in a court of law, but do not extend to stay proceedings in the admiralty or spiritual courts; the latter being granted to stay proceedings in the spiritual courts, the courts of admiralty, or in some other courts of equity, to restrain the negotiation of notes and bills of exchange, the sale of land, the sailing of a ship, transfer of stock, &c. In fact, the variety of cases is endless in which a court of equity grants relief to a plaintiff, in restraining the commission or the continuance of some act of the defendant.

INJURY, *in'-ju-re* (Lat. *injuria*), in Law, denotes something done contrary to law, to the hurt of another person or his property. According to Blackstone, injuries or private wrongs are an infringement or privation of the private or civil rights belonging to individuals considered as individuals. He distributes the several modes of redress of private wrongs into three several species: first, that which is obtained by the mere act of the parties themselves, as reprisal, self-defence, arbitration; secondly, that which is effected by the mere act and operation of law, as retainer, remitter; and, thirdly, that which arises from suit or action in courts, which consists in a conjunction of the other two, the act of the parties co-operating with the act of law; the act of the parties being necessary to set the law in motion, and the process of the law being in general the only instrument by which the parties are enabled to procure a certain and adequate redress.

INK, *ink* (Du. *inkt*, Fr. *encre*).—The basis of writing-ink is gallotannate of iron. It is generally made by mixing gall-nuts, sulphate of iron, and gum-arabic in different proportions. The following receipt gives an excellent ink, black, fluid, and permanent. Digest three-quarters of a pound of bruised nut-galls in a gallon of cold water, then add six ounces of sulphate of iron, and an equal weight of gum-arabic, and four or five drops of kreasote as an antiseptic. Let the mixture digest for three or four weeks, shaking it up now and then, after which decant the clear fluid. Ink long exposed to moisture and the atmosphere turns brown through becoming converted into peroxide of iron. The writing of documents which has become yellow and pale from age, may be restored by passing over it, with a fine brush, a solution of gall-nuts, which, uniting with the iron, re-forms a black gallotannate. Ink-stains submitted to the action of an alkaline carbonate during washing become converted into spots of yellow peroxide, or iron-moulds. These may be removed by dissolving the iron oxide with an acid that will not attack the fibre of the cloth, such as oxalic acid, a weak solution of hydrochloric acid, and several others. *Blue ink* is now frequently used; it is sometimes made from indigo, and sometimes from Prussian blue. *Red ink* may be made by infusing Brazil wood, cut into small pieces, for two or three days in weak vinegar. The infusion may then be boiled with the wood for an hour, and afterwards strained and thickened slightly with gum-arabic and sugar: a little alum improves the colour. A decoction of cochineal, with a little liquid ammonia, forms a beautiful red ink, but the colour is not permanent. *Indian ink* consists of cakes made of lamp-black and size, or animal glue. The Chinese, however, in manufacturing this ink, do not use animal glue, but vegetable juices, which render it more brilliant and lasting. When Indian ink is prepared with the best lamp-black, levigated with the finest gelatine, or solution of glue, it forms an ink of good colour, but wants the shining fracture and permanency of Chinese ink. Indian ink is used in Europe for designs in black and white, in which it possesses the advantage of being able to afford gradations of tone according to the degree of its dilution with water. *Marking inks* are of various kinds, and are used for marking linen. They generally consist of solutions of nitrate of silver. In some cases the fabric to be marked is previously moistened with an alkaline solution. By this means, oxide of silver is precipitated upon, and combines with the cloth when it is written upon, so as scarcely to be removed by any re-agent. *Sympathetic inks* are such as are invisible until heat or some other power is employed to develop them. Hellot's sympathetic ink consists of chloride of cobalt. The letters are invisible till the paper on which they are written is held to the fire: when the water evaporates, and the letters appear green. *Printing ink* consists essentially of a mixture of lamp-black, finely-divided carbon, and oil. The qualifications of a good printing ink are—1. that it should distribute freely and easily, and work sharp and clean; 2. that it should not have too much tenacity for the type, but should have a much greater affinity for the paper, and so come off freely upon it; 3. it ought to dry almost immediately on the paper, but not dry at all upon the type or rollers; this is particularly necessary in newspaper printing; 4. it should be able to withstand all the effects of time and chemical r- and should never change colour. The quali linseed oil employed, and even the character seed from which the oil is obtained, requires great attention. In making printing ink, the linseed oil is first clarified from all fatty matters, and the pure oil is boiled at a carefully regulated temperature. During the boiling, the best pale yellow soap is added, and the required driers are then mixed with it. The best lamp-

black is obtained from the smoke of naphtha, the combustion of which has been regulated with care. This black is ground up intimately with the drying oil, which has assumed almost the character of a varnish, and the ink is complete.

INLAYING, *in-lai'-ing* (Ang.-Sax.), is that branch of decorative art, applied chiefly to the manufacture of ornamental furniture, desks, workboxes, &c. It is performed by cutting grooves in the surface of any material, and filling up the hollows thus produced with some substance of a different kind or colour, so that a marked contrast may be obtained between the groundwork and the pattern that is inserted in it. Inlaying may be executed in any kind of hard wood, [illegible] tortoise-shell, ivory, horn, mother-of-pearl, &c., in the manner described, or by sawing out a pattern simultaneously in two veneers, or thin layers of wood, of different colours, that have been placed together for the purpose, and are afterwards glued to the surface of a piece of wood of inferior quality, the pattern that is cut out of each veneer fitting exactly in the space that is left in the others when the device has been sawn out and removed. This method resembles mosaic-work in some respects, but differs from it in this essential point, that the materials are not fitted together in such small pieces. (*See* MOSAIC-WORK.) Damaskeening is a species of inlaying in metals in which the natives of the East are very skilful. (*See* DAMASKEENING.) Two kinds of inlaying, often seen in old pieces of furniture, called "Buhl-work" and "Reisner-work," took their names respectively from two cabinetmakers who practised the art in Paris in the latter part of the 17th century. The former is the insertion of slips and scroll-work of brass into a groundwork of dark or clouded wood, and the latter, the insertion of a pattern, cut in ebony, into tulip-wood, or any other wood of a light colour. In some specimens the effect of painting is produced by the use of a variety of pieces of wood of different colours. Inlaying, when applied to the formation of flooring, is called marquetry and parquetry. (*See* MARQUETRY, PARQUETRY.)

INN, *in* (Sax. *inn*), is a place of entertainment for travellers. If an innkeeper, or other victualler, hangs out a sign and opens his house for travellers, it is an implied engagement to entertain all persons who travel that way, and upon this universal assumption an action will lie against him for damages, if he, without good reason, refuses to admit a traveller. Innkeepers are also responsible for the safe custody of the goods of their guests while they are under their roof; but if the goods are lost through any negligence of the owner himself, then the responsibility of the innkeeper ceases.

INNATE IDEAS, *in'-nait* (Lat. *innatus*, inborn), in Phil., are such as are inborn, and belong to the mind from its birth. "These," says Descartes, "I have called innate in the same sense in which we say that generosity is innate in some families, or that certain diseases (as the gout or stone) are innate in others; not that the children of those families labour under such diseases in their mother's womb, but that they are born with a certain predisposition or faculty of contracting them." It is now generally agreed among philosophers, that the mind is originally constituted with its own fundamental laws of thought, which will inevitably cause it to develop only to certain effects, and that at the same time a certain external influence, a contact with the outward world, is absolutely necessary, without which it would not develop at all.

INNOCENTS' DAY, *in'-no-sents*, a festival celebrated in the calendar on the 28th December, in commemoration of the murder of the infants by Herod, when he wished to destroy the infant Saviour.

INNOMINATUM, OS, *in-nom-in-ai'-tum* (Lat. *in*, without; *nomen*, a name), is the name given to the large irregular bone situated at the side of the pelvis. It is composed of three bones, which are distinct in the young subject, and are the *os ilium*, or haunch-bone; the *os ischium*, or hip-bone; and the *os pubis*, or sham-bone.

INNS OF COURT.—When the court of Common Pleas was fixed at Westminster, in terms of an article in the Magna Charta, which declared that it should no longer follow the king's court, but be held in some certain place, numerous professors of the municipal law were thus brought together and formed into an ag[illegible] body. They naturally fell into a kind of [illegible] order, purchased or became possessed, at various times, of certain houses between Westminster and the City, where exercises were performed, lectures read, and degrees at length conferred in the common law. The degrees were those of barrister, answering to bachelor in the universities. According to Fortescue, there were two sorts of collegiate houses,—one called Inns of Chancery, in which the younger students of the law were usually placed, and the greater inns, called the Inns of Court, into which the more advanced students were admitted. The Inns of Court are Lincoln's Inn, the Inner Temple, the Middle Temple, and Gray's Inn. These four courts alone possess the power of conferring the rank of barrister-at-law, a rank which constitutes an indispensable qualification for practice in the superior courts. (*See* BARRISTER.) Lincoln's Inn appears to have taken its name from one of the earls of Lincoln, whose house came to be appropriated to students of law. It has a magnificent chapel, built by Inigo Jones, and an elegant hall and library, built by Hardwick, in the Tudor style, in 1845. The library contains a very large and valuable collection of books. The Inner and Middle Temples came into the hands of the professors of law after the dissolution of the Knights Templars. In the reign of Henry VIII. the members of the Temple divided into two societies, afterwards known as the Inner and Middle Temples. The magnificent Temple church, common to both societies, was founded by the Templars upon the model of that of the Holy Sepulchre at Jerusalem. Gray's Inn takes its name from the lords Gray of Wilton, and was established in the reign of Edward III. The chapel and hall are plain buildings. Each inn of court is governed by a body of their own, known by the name of Benchers. Besides the four inns of court, there are eight inns of chancery, which are now only used as chambers, principally by solicitors and attorneys. They are Furnival's Inn, Thavies' Inn, Clifford's Inn, Clement's Inn, New Inn, Lyon's Inn, Staple Inn, and Barnard's Inn.

INOCARPUS. (*See* THYMELACEÆ.)

INOCULATION, *in-ok-u-lai'-shun* (Lat. *inoculatio*), in Med., is the insertion of a poison into the body of a person, more particularly applied to the practice of producing small-pox by taking a small quantity of the fluid from the eruption on the skin of one person, and inserting it under that of another. In this way a much milder form of the disease was produced than if it had been taken in the natural way. Hence the mortality of the disease was much lessened; for, whereas of those that take the disease in the natural way, one in every five or six dies; of those that are inoculated, there are not more than one in five or six hundred carried off. It was also, however, not without its evils, as it exposed the person to some risk, who might not have taken it naturally, and, by introducing the disease into a district previously free from it, might be the means of communicating it to others. Inoculation is generally said to have been introduced into this country about 1721, by Lady Mary Wortley Montague, who had seen it practised in Turkey, where it had been long known. It appears, however, to have been known before this time in the south of Wales and the Highlands of Scotland. Since the introduction of vaccination, inoculation has fallen into disuse. (*See* VACCINATION.)

INORGANIC CHEMISTRY. (*See* ORGANIC and INORGANIC CHEMISTRY.)

INQUEST, *in'-kwest* (Lat. *inquisitio*), in Law, is an inquiry into any cause, civil or criminal, by jurors impanelled for that purpose. An inquest of office is an inquiry made by the king's officer, his sheriff, coroner, or escheator, or by writ to them sent for that purpose, or by commissioners specially appointed, concerning any matter that entitles the king to the possession of lands or tenements, goods or chattels; as forfeiture for offences, wreck, treasure trove, &c. A coroner's inquest, held by a coroner and a jury, is for the purpose of inquiring when any person is slain, or dies suddenly, or in prison, concerning the [illegible] of his death, and is one of the greatest safeguards of life in this country. It is indispensable that the coroner and the jury should have a view of the body; for if the body

be not found the coroner cannot sit. If any be found guilty by this inquest, of murder or other homicide, the coroner is to commit them to prison for further trial, and is also to inquire concerning their lands, goods, and chattels, which are forfeited thereby. If a body liable to inquest has been buried before the facts came to the knowledge of the coroner, he has power to cause it to be disinterred, for the purpose of holding the inquest. The coroner is required to put in writing the evidence given to the jury before him, or as much thereof as shall be material; and to deliver the same to the proper officer of the court in which the trial is to be, before or at the opening of the court, in all cases in which any person shall be indicted for manslaughter or murder; and he has also authority to bind, by recognisance, all such persons as know or declare anything material touching the said manslaughter or murder, to appear at the trial, and there to prosecute, or give evidence against the party charged. (*See* CORONER.)

INQUIRY, COURT OF, *in-kwi'-re* (inquiry, from Nor. *enquerre*, from *querer*, to seek), an office sometimes appointed by the crown to ascertain the propriety of resorting to ulterior proceedings against a party charged before a court-martial.—*Ref.* Wharton's *Law Lexicon.*

INQUIRY, WRIT OF, a term applied in Law to a judicial process addressed to the sheriff of the county in which the *venue* is laid, to summon a jury, in order to inquire what damages a plaintiff has sustained in an action upon the case where judgment goes by default.

INQUISITION. (*See* vol. I. of this work.)

IN RE, *in re* (Lat., meaning literally, *in the affair*), an abbreviative expression used in Law for *in the matter of, in the case of, &c.*

INSANITY, *in-săn'-e-te* (Lat. *in*, not; *sanus*, sane, sound), is one of the most terrible disorders to which the human race is subject; and one, also, the nature of which is the least understood. Of the nature of that spirit by which the body of man is animated we know little, and not more of the diseases or infirmities to which it is subject. The causes which may lead to insanity, particularly in those whose mental constitution is weak, are very numerous. In many cases, the tendency to insanity is hereditary, and transmitted from parents to children. One of the most fertile causes of insanity in this country is drunkenness. Excessive study, strong mental excitement, grief, jealousy, disappointment, frequently, also, lead to it. Religious excitement is also not an unfrequent cause. Sometimes insanity comes on quite suddenly, without any warning whatever; at other times there is a previous derangement of the animal functions, loss of appetite, restlessness, and want of sleep. It is usual to distinguish insanity into different kinds; as,—1. Moral insanity, in which there is a morbid perversion of the feelings, affections, and active powers, without any illusion or erroneous conviction impressed upon the understanding. 2. Intellectual insanity, affecting the reasoning powers, and which may be either general or partial,—the latter as in monomania. 3. Mania, or raving madness, in which the mental faculties are notoriously impaired, but the patient gives way to all sorts of extravagances, and, if not prevented, will do mischief to himself or others. 4. Dementia, imbecility, fatuity, when the mental powers become gradually impaired, the sensibilities diminished, and the person at length becomes careless, or dead, to all that is going on around him. Usually, however, two or more of these kinds occur together. Moral insanity frequently manifests itself in a desire to steal, or appropriate the property of others. In monomania, the patient reasons correctly upon all matters except one, which forms the subject of his insanity. Imbecility usually commences with loss of memory and the power of concentrating the attention, for any time, upon one subject; then all control is lost over the thoughts, and the mind wanders meaninglessly from one subject to another; at length there is a carelessness to all that is going on around, and life may become a mere existence, the mental faculties being entirely lost. Idiotcy differs from imbecility, in being congenital, while the latter is acquired, or produced by disease. Idiotcy may be produced by various causes connected with the parents; as intermarriages of near relatives, intemperance, scrofulous habits, some powerful influence acting on the mother during pregnancy. Idiots present every degree of mental imbecility, down to the lowest shade, without sense sufficient to satisfy the mere wants of nature. The head of the idiot is usually very small, particularly in the region of the forehead; in some cases, however, it may be quite natural, and in others large and misshapen. The beneficial effects of attention to the physical health, and of education, are manifested even in the case of idiots. (*See* CRETINISM.) The chance of recovery depends greatly on the complication, or otherwise, of insanity with other diseases, particularly epilepsy or paralysis, with either of which it is nearly hopeless. It is also influenced by the form of the disease, the period of its duration, the age, sex, and constitution of the patient. The mean duration of cases terminating favourably is from five to ten months; after the latter period, recovery is very doubtful. In advanced life, insanity is generally permanent, and imbecility is very rarely curable. While insanity may arise from some affection of the brain which speedily terminates in death, yet, in general, it is not necessarily a fatal disorder, for lunatics have been known to live thirty, forty, or fifty years after being seized with their disease. It is one of the signs of the advance of the present age, that the treatment of the insane is no longer what it was; they are no longer loaded with chains and confined to some dungeon, but are treated with kindness and consideration, and allowed all the liberty that the nature of their malady admits of. In the cure of insanity, in which great progress has recently been made, the means adopted naturally resolve themselves into medical and moral. When the malady proceeds from, or is accompanied by, physical derangement, as it usually is, it is necessary to ascertain the nature of this, and to take means for its removal. If there be excitement and inflammatory action, mild antiphlogistic measures will be necessary, together with aperients and a low diet. If, on the contrary, there is debility and prostration of strength, a nourishing diet will be required. When, as is often the case, want of sleep is an attendant symptom, opiates are to be given. In all cases, exercise, fresh air, and cleanliness, are required. The moral treatment of the insane consists in diverting their thoughts by occupations and amusements, and in gaining their confidence by kind and conciliatory measures. To M. Pinel, of France, is the world indebted for having been the first to introduce conciliatory measures in the treatment of the insane.

INSCRIPTION, *in-skrip'-shun* (Lat. *in* and *scribo*, I write), a term applied, in Archæol. to designate any monumental writing intended to commemorate a remarkable event, or to hand down to posterity the name of the builder of a monument, or of the person in whose honour it was erected. From the very earliest period in the history of antiquity, when documents are rare, and, indeed, often wanting altogether, inscriptions appear to form one of the most important sources from which we have derived our knowledge of the public, private, religious, and social life of the ancients. After the invention of the alphabet, the earliest application of the art of writing was by means of engravings on wood, stone, and metals; and even after other, and far more convenient, materials came into use, this method was still preferred; the reason for which was, no doubt, on account of its durability. From all nations, therefore, who have arrived at a certain stage of civilization, have we inscriptions, and these self-same records have been handed down to us on the walls of temples, on tombs, triumphal monuments, statues, tablets, vases,—in fact, every idea which could lead to the furtherance of inscription was eagerly seized upon; and the result has been a perfect museum to the moderns of this form of ancient lore. Inscriptions, more commonly, are limited to portraying the deeds and names of memorable men; but we have also records of battles, dates of important events, chronicles of laws, decrees, legends, moral and scientific precepts, and chronological tables beyond number. We have thus important records of the annals of antiquity; and the Assyrians, the Egyptians, the Indians, Persians, Etruscans, Greeks, and Romans, all have left such traces behind them.

The Assyrian inscriptions have been found in immense numbers, on the walls, bricks, and other substances which graced the cities of Nineveh and Babylon, and these have been mostly found written in the cuneiform character. The subject of these is generally the histories of the different kings; among whom are many who have left no farther traces behind them. The Egyptian inscriptions are nearly totally confined to hieroglyphics, and the hieratic, demotic, and Coptic, or ancient Egyptian characters. These latter have served even more than those of Assyria, to throw light on some of the darkest points of antiquarian history. The monuments of Phœnicia which bear inscriptions are but few in number; most of the records of this people being found on medals, at least up to the time of Alexander. The earliest Greek inscriptions that we may really consider as genuine, are those which commemorate the victors in the Olympic games. All those belonging to the Attic race are composed either in prose or verse; but the former inscriptions are by far the most numerous. "All Greek inscriptions are written in capital letters, and without any punctuation, or separation of the several words, which renders it difficult to read and understand them properly. Some of the earliest inscriptions are written like the Hebrew, from the right to the left; others varied their lines, the first being written from the left to the right, and the second from the right to the left. In this manner, which is called boustrophedon, the laws of Solon were written, and some specimens are still extant. The method of later times was to write, like ourselves, from the left to the right. But besides these general distinctions, there occur a great variety, and some modifications of writing, which are the result of mere fancy. Another important point, which it is necessary to know before attempting to read Greek, and more especially Roman inscriptions, is the abbreviation of names and words (*sigla*), which is described and explained in several works, such as Nicolai's "De Siglis Veterum," Lugdun. 1730, 4to; Maffei's "De Græcorum Siglis lapidariis," Verona, 1746, &c. &c. The oldest Latin inscriptions are those which were found at Rome, and which are now kept in the monastery of Einsiedeln: they are written on parchment, and probably belong to the 10th or 11th century. The whole number now known to exist exceeds 600,000. For those who wish to enter fully into the subject, the following works are the best references:—Zaccaria's *Institutione Lapidaria*, Rome 1770, and Venice 1792; Morcelli's *De Stilo Inscriptionum Latinarum Libri tres*, Rome, 1781, and reprinted in his *Opera Epigraphica*, Patavii, 1819, 5 vols. 8vo; also Orellis's *Introduction to his collection*.

INSECTA, *in-sek'-tă* (Lat. *insectus*, divided into segments), a class of invertebrate animals, belonging to the sub-kingdom *Annulosa*. According to Latreille's arrangement, in the "Règne Animal," the class Insecta forms the third great division of the articulated animals, referring to the articulations, or innumerable joints, of which this class of animals is composed. The following may be taken as a definition of a true insect:—An articulated animal having six legs, two antennæ, two compound eyes; a small brain at the anterior extremity of a double medullary chord; circulation effected by a pulsating dorsal vessel provided with numerous valves; respiration by tracheæ, which form two lateral trunks, and ramify through the body; generation oviparous; two distinct sexes; adult state attained through a series of metamorphoses. (*See* INSECT-TRANSFORMATIONS.) In general, every insect possesses two pairs of wings; the trunk in the adult animal is usually composed of three chief parts,—the head, thorax, and abdomen. The trunk of an insect may also be described as consisting of thirteen segments; of which one constitutes the head, three the thorax, and nine the abdomen. The principal parts of the head are the clypeus, or upper part adjoining the labrum; the vertex, or summit of the head; the occiput, or hinder portion; and the genæ, or cheeks. Oculi, the eyes, are almost always two in number, placed on either side of the head, and composed of hexagonal lenses. The stemmata are minute simple eyes, and may be seen in the orders Hymenoptera, Orthoptera, and Hemiptera. They are also possessed by the larvæ of coleopterous insects. The antennæ are two-jointed organs, usually springing from the upper surface or side of the head, near the eyes. These organs vary greatly, not only in different species, but often in the sexes of the same species. Much difference of opinion exists as to the use of these antennæ. By some, they are considered organs of hearing, while others aver that they are organs of touch or smell. It is probable that they are used for different purposes by different varieties of insects. The trophi, or parts of the mouth, consist of the labrum, or upper lip; the labium, or under lip; the mandibles, or jaws; and maxillæ, or feeder-jaws. The term thorax is applied to all that portion of an insect which lies between the head and the abdomen, and to which the legs and wings are attached. The three segments of the thorax mentioned before are called the protothorax, the mesothorax, and the metathorax respectively, passing from the head to the abdomen. The protothorax bears the anterior pair of legs, and is largely developed in the Coleoptera, Orthoptera, and Hemiptera; but in the Lepidoptera it merely forms a narrow ring, and in the Hymenoptera, frequently a distinct neck. The mesothorax is more complicated than the first section, since it bears a pair of legs and the anterior pair of wings. It is well developed in all insects. The metathorax bears the posterior wings, and is well developed in those animals which have them; but in those insects which want them, as the Diptera, the metathorax is small. In the abdomen of insects, although nine segments are always visible in the larvæ, there are seldom more than seven or eight visible joints in the perfect insect. The substance of which the abdominal segments are composed is always softer and more flexible than that of the head and thorax. To the abdomen, which never possesses organs of locomotion, are attached various appendages, which differ very much in different families. The digestive system is well developed, and consists of an intestinal canal, in which a crop, gizzard, stomach, and small intestine, are generally distinct; but these parts vary according to the nature of the food, similarly to those of the higher order of animals. The circulation of the blood in insects is carried on by distinct vessels, and also by a channel in the intestines. Its central organ is the dorsal vessel. The muscular system of insects is highly developed, and their locomotive powers far surpass those of any animal whatever. Insects possess great powers of multiplication. Their eggs are very variable in shape, but their general form is oval; they are, however, often round, and sometimes cylindrical. In the ordinary language of entomology, the term "larva" is applied to the insect from the date of its escape from the egg to the time when its wings begin to appear. (For classification of insects, see ENTOMOLOGY.)

INSECTIVORA, *in-sek-tiv'-o-ră* (Lat., insect-eaters), an order of carnivorous quadrupeds synonymous with Glires, and deriving its name from the habits of the species belonging to it. Their distinguishing characteristics are the conical points on their teeth, for the purpose of crushing the hard outer coverings of the insects on which they feed. They are divided into four different families;—the Talpidæ, or moles; the Soricidæ, or shrews; the Erinaceadæ, or hedgehogs; and the Tupaidæ, or banxrings, a group of animals inhabiting the East Indies, and bearing a close resemblance to squirrels in their appearance and habits. The term Insectivora is also applied to an order of birds in the ornithological system of Temminck.

INSECT-TRANSFORMATIONS, *trăns-for-mai'-shuns* (Lat. *trans*, beyond; *formo*, I make).—When the larvæ of an insect leave the egg, they are often very unlike the parent, and require several changes of form before they assume the perfect shape. As the young animal increases in size, its integument becomes too small, and is thrown off, while a new one forms in its place. This moulting or change of skin takes place several times, generally as many as five, before the larvæ attain their full growth. At the period of the last change, many insects spin a cocoon of silky fibres, others dig a hole in the ground, and in these retreats await their second transformation, changing into the state of nymphæ or pupæ while there. They continue immovable, and in a state of repose, for a certain time, varying from a few

days to some weeks, months, or even, in a few, to a couple of years. Great changes take place in the organs of insects during this period. They gradually become developed, till, at the proper time for becoming mature, the perfect insects burst forth from their pupa-cases. In the course of insect-transformation, the grade of development at which the insect primarily leaves the egg is very different in the several orders and families. In all cases, the embryonic mass within the egg is first converted into a footless worm, resembling the higher Entozoa, or the inferior Annelida, in its general organization, but possessing thirteen segments, the typical number of the class of insects. In the Diptera, Hymenoptera, and in some of the Coleoptera, the head of the larvæ which are known as "maggots," differs little from the segments of the body, the eyes in many cases not being developed, and the mouth being furnished with a mere suctorial disc. In the Lepidoptera, and most of the Coleoptera, at the time of escape, the larva possesses the rudiments of three pairs of thoracic legs, although they are little else than simple claws, except in the carnivorous beetles. These larvæ are usually designated "caterpillars." The transformation of insects was observed by the ancient Greeks and Romans, and amongst them a butterfly, or perfect insect, was used as a symbol to represent the soul.

INSOLVENCY, *in-sol'-ven-se* (Lat. *in*, not; *solvo*, to pay), in Law, the state of a person who has not sufficient property for the full payment of his debts. Several statutes at various periods were enacted for the relief of insolvent debtors, until the union of the Bankrupt and Insolvent courts in 1861. Up to that period, debtors were relieved by means of the Insolvent court, which consisted of four commissioners, and other officers, with a court-house in London. Single commissioners, however, made circuits three times a year through England and Wales. The method of procedure was as follows:—The court either acted upon petition from prisoners in actual custody, or, if the prisoner did not pray, on petition from a creditor. An order was then made, vesting the prisoner's estate and effects in the provisional assignee of the court which, however, was void, if the petition were dismissed. The duty of the provisional assignee was to receive and dispose of the property, and account for the produce to the court. The insolvent debtor then delivered into court a schedule, containing a full account of his property. The petition was then heard; and at the hearing, all creditors might oppose, and compel a full investigation of the prisoner's accounts. The court had the power to discharge the insolvent, or to remand him for a discretionary period, not exceeding three years. This law was embarrassed with several evils, injurious alike both to debtors and creditors. An act was consequently brought in for the purpose of repealing the various acts for the relief of insolvent debtors, and more especially to amend "the Bankrupt Law Consolidation Act, 1849." This act received the royal assent on the 6th of August, 1861. The amendments in the statute are of a disconnected character; but the principal object is, that the property of any one who is unable to pay his debts in full, or perform his engagements with his creditors, should be administered by the court of Bankruptcy, for the benefit of all his creditors, without reference to those distinctions which before prevailed, as to traders and non-traders. The inconvenience of these distinctions caused numerous alterations to be made in the department of the law of debtors and creditors during the last half-century, and a most artificial system was the result. The principal alterations made by the act of 1861 will be found detailed in the article BANKRUPT. The benefit of the act, known as the Great Insolvent Act, from the time of its passing in 1814, to March, 1827, a period of thirteen years, was taken by 50,783 insolvents. A large number of imprisoned insolvents were released in November, 1861.

INSPIRATION. (*See* REVELATION.)

INSTALLATION, *in-stăl-lai'-shun* (Lat. *in* and *stallum*, a seat), a term applied to the ceremony of instating persons in honours and dignities. Thus, we speak of the installation of a knight of the Garter in the chapel of St. George at Windsor; the installation of a chancellor in a university; or of a dean, prebendary, or other ecclesiastical dignitary, in the stall of the cathedral to which he belongs.

IN STATU QUO, *in stai'-u kwo*, literally, 'the place in which,'—a phrase synonymous with 'in the same place.'

INSTINCT, *in'-stinkt* (Lat. *instinctus*, inwardly moved, suggestion, impulse), in Phil., according to Dr. Reid, "is a natural, blind impulse to certain actions, without having any end in view, without deliberation, and very often without any conception of what we do;" and, according to Sir W. Hamilton, it is "an agent which performs, blindly and ignorantly, a work of intelligence and knowledge." Various other definitions are given. Brougham says that instinct is distinguished from reason, in that "it acts without teaching, either from others,—that is instruction, or from the animal itself, —that is experience;" "it acts without knowledge of consequences; it acts blindly, and accomplishes a purpose of which the animal is ignorant." In general, we find that instinct and reason prevail in an animal in the inverse ratio to each other. Hence, in man, whose reasoning

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out any consciousness on the part of the agent, of the end which it serves; it is effected as perfectly the first time as at any subsequent period; and is unsusceptible of any adaptation to particular emergencies; while a reasonable action, on the contrary, is one which always implies a consciousness, on the part of the agent, of the end in view,—which becomes only progressively perfect, and which is capable of being variously modified according to existing circumstances. Some philosophers have held that there is no real distinction between instinct and reason. Darwin (*Zoonomia*) regarded all instinctive acts as really intellectual operations; while Smellie, on the other hand, viewed reason itself as really an instinct. Hume, too, asserts "that the experimental reasoning itself, on which the whole conduct of life depends, is nothing but a species of instinct or mechanical power, that acts in us unknown to ourselves; and its chief operations are not directed by any such relations or comparisons of ideas as are the proper objects of our intellectual faculties." Three classes of theories have been proposed, to account for the instinctive actions:—1. The physical, which makes them depend upon the structure and organization of the animal. 2. The psychical, which regards them as the result of mental powers or faculties possessed by the animals, analogous to those of the understanding in man. 3. The supernatural, which views them as the workings of an intelligence superior to man, or the Supreme Being. Of this last opinion was Sir Isaac Newton. According to Dr. Bushnan, instinctive acts can be traced to the direct effect of sensation, and are dependent on either external or internal stimuli; as externally from the senses, internally from feelings,—as hunger, thirst, &c. The great source of instinctive acts in the lower animals are, he says, smell and taste. They are all, however, referable to some uneasy sensations proceeding from certain irritations of particular organs; or, according to Broussais, they arise from "sensations which solicit a living being to execute involuntarily, and often unconsciously, certain acts necessary to its welfare."

INSTITUTE, *in'-sti-tute* (from Lat. *instituere*, to found), a learned body which was organised in France shortly after the first storm of the revolution of the last century had spent its fury. Its necessity arose from the fact of all the academies and art institutions having been destroyed; consequently, the *Institut National* was formed on the 25th October, 1795, out of the remnants of the five academies; namely, the French Academy, the Academy of Inscriptions and Belles-Lettres, that of the Mathematical and Physical Sciences, of the Fine Arts, and of the Moral and Political Sciences, all united in one harmonious whole. The great object designed by the Institute was the advancement of the arts and sciences, by continual researches, by the publication of new discoveries, and by a correspondence with the most distinguished scholars of all nations, and especially by promoting such scientific and literary undertakings as would tend to the national glory and welfare. The Institute, since the restoration of the empire in France, is known by name of the *Imperial Institute*.

INSTITUTION, *in-stit-u'-shun*, a name given to a system, plan, or society, established, either by law or by the authority of individuals, for promoting any object, public or social. Thus, a college is termed a *collegiate institution*; an academy of belles-lettres, a *literary institution*; an almsgiving society, a *benevolent* or *charitable institution*; while a banking company or insurance office is a *commercial institution*. Hospitals are likewise charitable institutions, and will be found given under their respective heads. (*See* also MECHANICS' INSTITUTIONS.)

INSTRUMENTAL MUSIC, *in-stru-men'-tăl* (from Lat. *instrumentum*, an instrument).—All music composed for instruments is so called, in contradistinction to *vocal music*. This term is more especially applied to all the greater compositions, in which there is no part for the voice. Until the middle of the last century, the Italian composers used no other instruments in their great pieces than violins and bass-viols; at that time, however, they began to use the hautboy and the horn. Even to the present time, the Italians employ wind instruments much less than either the French or Germans. In general, symphonies, overtures, sonatas, fantasias, solos, dances, marches, &c., belong to instrumental music.

INSTRUMENTS, ASTRONOMICAL.—The instruments used for astronomical purposes are numerous and varied in construction. Among the principal of them may be named the telescope, mural circle, transit circle, altitude and azimuth circle, repeating circle, equatorial instrument, sextant, collimator, zenith sector, &c., many of which are described under their respective headings. (*See* TELESCOPE, MURAL CIRCLE, TRANSIT INSTRUMENT, REPEATING CIRCLE, EQUATORIAL INSTRUMENT, ZENITH SECTOR.) Chronometers and sidereal clocks are also used for measuring time, latitude and longitude, and the right ascension of heavenly bodies. (*See* CHRONOMETER, HOROLOGY, PENDULUM, SIDEREAL CLOCK.) The micrometer and vernier are contrivances that are attached to astronomical instruments, for measuring the apparent diameter of the sun, moon, planets, and stars, and very minute divisions of space. (*See* MICROMETER, VERNIER.)

INSTRUMENTS, MATHEMATICAL.—A set of implements for describing mathematical diagrams and drawings, of which the figures, or elementary parts, are composed of straight lines, circles, or arcs of circles. The most useful mathematical instruments are,—a drawing-pen; a pair of plain compasses, usually called *dividers*; a pair of drawing compasses, with a foot adapted for pen and pencil; a pair of bow compasses; a pair of triangular compasses, consisting of three legs, two of which are movable at the head in the same manner as the dividers or the drawing-compasses,—the third leg, made of steel, is fitted into a socket through a knob projecting from the side of the head, by which means it is movable in almost any direction, while the other two remain stationary; a pair of proportional compasses; a set of spring bows for small work, consisting of spring dividers, spring bow-pen, and bow-pencil; a protractor in the form of a semicircle or of a rectangle; a plain scale; a sector, and a parallel rule. The *drawing-pen* is used in making ink lines by the edge of a ruler; the cavity between its plates receives the ink, which is supplied either by a common quill pen or a camel's-hair brush. The *dividers* are used in order to take the extent of any line or surface from one point to another, in order to transfer it to some other line; to repeat any extension upon a straight line in an equimultiple; to divide a straight line, or the circumference of a circle, or any part of it, into equal parts; to proportion the parts of a drawing by scale, or to construct a drawing similar to one already drawn; to construct an angle of any number of degrees, or to measure the quantity of any angle in degrees. *Drawing-compasses* are used either for describing temporary arcs or whole circumferences with black-lead pencil, or permanently in ink. *Bow-compasses* are used in describing small circles. *Triangular compasses* are used in transferring a given angle from one place to another, or in taking the three angles of a triangle at once, and transferring them to any given place. These compasses, though very useful, are not well known; they are serviceable in copying all kinds of drawings, as from two fixed points the position of a third can always be determined. *Proportional compasses* are used in making one drawing similar to another without the use of scales or triangular lines. The use of the *protractor* is to lay down an angle of any number of degrees: the *rectangular protractor* is also used for the same purpose. The *parallel rule*, as its name implies, is an instrument by which straight lines are drawn parallel to one another. The ordinary *plain scale* has the following lines or scales upon it:—a line of 6 inches; a line of 50 equal parts; a diagonal scale: these are put on one side; on the other side are a line of chords marked C, and seven particular scales of equal parts, or decimal scales of different sizes; the numbers at the beginning of each denoting how many of the small divisions at the beginning are contained in an inch. The *sector* is a most useful instrument, since it forms a universal plain scale.

INSTRUMENTS, MUSICAL.—Sonorous bodies artificially constructed, for the production of harmonious sounds. They may be divided into four classes; viz., keyed, stringed, wind, and pulsatile. To the first of these divisions belong all such instruments as the organ, piano-forte, harmonium, &c. To the second, all of the violin and harp kind, &c. The third includes flutes, clarionettes, hautboys, ophicleides, &c., and all brass instruments; while the fourth contains drums, cymbals, tambourines, &c. All modern, as well as the most important of the ancient, musical instruments, will be found described under their respective names.

INSURANCE, or ASSURANCE, *in-shu'-rans* (Fr. *sur*, sure, certain), is a contract between two parties, in which one of them, the insurer, undertakes, in consideration of a certain sum received or promised, called the premium, to indemnify, or assure, the other against a certain amount of loss from the occurrence of a specified contingency, as the burning of certain premises, the loss of a certain ship, or the death of a certain person. Such contracts are for a certain period, either a fixed time, or for a period terminable on the occurrence of an uncertain event, as the termination of a voyage. The deed by which the insurer becomes bound is called a policy of insurance, and the contingency assured against is termed the risk. The principle of insurance is founded upon the doctrine of probabilities. According to this latter, if we take a sufficiently extended range of instances, the probability of a certain event happening can be ascertained with a considerable degree of accuracy. Thus, though, as regards any individual, it is impossible to predict that he shall die within twelve months, yet, if we take a number of individuals, say 10,000, and find that, over a period of 10 years, so many have died annually, we may generally predict, with tolerable certainty, that a like number will die annually in similar circumstances. If, however, in place of 10,000 persons, we take 1,000,000, and in place of 10 years, 50 years, we shall so much the more counteract the minor disturbing elements, that, when acting on smaller numbers, materially affect the result, and thus arrive at a greater degree of certainty. It is in this way that insurers calculate their risks and estimate their premiums. From extended series of observations and carefully prepared tables, they know the chances of the event insured against happening, and determine the amount of premium accordingly. Thus, if, out of 100 risks, the insurer expects to have two losses, he calculates so as that the 100 premiums may cover the two losses, together with his own business expenses, &c. The business of insurance is generally carried on by companies having a large subscribed capital, by means of which they are able, without difficulty, to meet any heavy loss, while their premiums being proportioned to their risks, their profit is, at an average, independent of such contingencies. The advantages of insurance are very great. While, to one person, a merchant, the loss of a vessel might be a very serious matter, he can thus, by the payment of a certain sum, provide against it, so that he may carry on his business with a feeling of perfect security. The principle of insurance is that of equalizing the accidents of life or fortune, by uniting many persons together, who agree to bear jointly the losses of any individual. "It is, in fact,"

says Prof. De Morgan, "in a limited sense and a practicable method, the agreement of a community to consider the goods of its individual members as common. It is an agreement that those whose fortune it shall be to have more than average success shall resign the overplus in favour of those who have less. And though, as yet, it has only been applied to the reparation of the evils arising from storm, fire, premature death, disease, and old age, yet there is no placing a limit to the extensions which its application might receive, if the public were fully aware of its principles, and of the safety with which they may be put in practice."—(*Essay on Probabilities.*) It has been disputed whether the system of insurance was known or practised by the Romans, from certain passages occurring in some of their historians; but be this as it may, there is evidence to show that it was practised in Italy as early as the 14th century, and Uzzano, a Florentine merchant, whose writings are placed about 1400, quotes the rate of assurance from London to Pisa, also from Bruges. It is generally believed that the system was introduced into England by the Lombards, who established themselves in London at a very early period. The first English statute relative to assurance is 43 Eliz. c. 12, 1601, and the system is there designated as "tyme out of mynde, an usage amongste merchants." The three great divisions of insurance are marine, fire, and life insurance. The last two are of much later origin than the first. A marine insurance is a contract entered into between persons having some interest in vessels, their cargo or their earnings, on the one side, and the insurers, or persons who, on the payment of a certain premium, undertake to indemnify the former against specified losses during a particular voyage, or for the time specified in the policy. The insurers are usually called underwriters, because they write their names at the foot of the policy. The largest underwriting business in the world is carried on by the underwriters at Lloyd's, who have their agents stationed all over the world. The contract of insurance is one pre-eminently based on the assumption of perfect good faith between the parties; and hence any concealment, or misrepresentation of material facts, likely to affect the underwriter's estimate of the risk, will render the policy void, even where the concealment or misrepresentation may have resulted from a mistake, without the intention to deceive. The policy of insurance is printed with blank spaces, to be filled up with the particulars of each case; and the perils insured against are described as "the adventures and perils of the seas, men-of-war, fire, enemies, pirates, rovers, thieves, jettisons, letters of mart and counter-mart, surprisals, takings at sea, arrests, restraints, and detainments of all kings, princes, and people, of what nation, condition, or quality soever; barratry of the master and mariners, and all other perils, losses, and misfortunes, that have, or shall come to the hurt, detriment, or damage, of the said goods, merchandises, and ship, &c., or any part thereof." The risk on the ship in voyage policies commences at and from the place specified in the policy, and continues till she has been moored for twenty-four hours in safety at the destination specified. If the ship should deviate from the regular and usual course of the specific voyage insured, without necessary or reasonable cause, the underwriter is thenceforth discharged from all liability under the policy. In all voyage policies, it is implied in the contract, that the ship shall be seaworthy at the commencement of the risk; but it has recently been decided that there is no such warranty of seaworthiness implied in time policies. In case of any loss or misfortune, the insured and their servants are expected to labour for the recovery of said goods, merchandise, or ship, or any part thereof, for the insurers, who will bear the expenses thereof. When an absolute total loss occurs, the assured are entitled to recover the amount of the policy, without giving any notice of abandonment; when the subject insured is so seriously damaged that its recovery might cost more than its eventual value, it forms a "constructive total loss," and notice of abandonment requires to be given by the insured, when the underwriters become owners of the vessel, and bound for the amount of the insurance. When there is partial loss, or damage, arising from any of the causes insured against, it is determined by what is termed particular average. In every case of partial loss, the underwriter is liable to pay such proportion of the sum he has subscribed as the damage sustained by the subject of insurance bears to its whole value at the time of insurance. A stamp duty is levied on all policies of marine insurance, which is made to increase [illegible] risk. On voyage policies, it is for every £100 or part of £100 insured, if the premium does not exceed 10s. per cent. 3d.; 10s., and not more than 20s., 6d.; 20s., and not more than 30s., 1s.; 30s., and not more than 40s, 2s.; 40s., and not more than 50s., 3s.; more than 50s., 4s. On time policies, for every £100, or part of £100, when the time does not exceed six months, 2s. 6d.; exceeding six months, 4s.; it being unlawful to insure for any period exceeding twelve months. The amount yielded by the tax on marine insurances in 1862 was £339,043.—(*Ref.* Arnould *On Marine Insurance.*) *Fire Insurances* are almost invariably effected by joint-stock companies, of which there are, with few exceptions, one or more in all the considerable towns throughout the empire. Some of these insure entirely at their own risk, and for their own profit; in others, which are called mutual insurance companies, every person insured becomes a member or proprietor, and participates in the profits or loss of the concern. The great fire of London in 1666 directed people's minds to the means of avoiding the calamities of such an event, and various schemes for mutual protection and relief were submitted to the common council. At length, in 1681, a company was formed for this purpose, and after a time, it was succeeded by several others. In 1696, the Hand-in-Hand fire-office was established, and in 1706 the Sun. There are now upwards of seventy different offices in the United Kingdom. In fire insurance, the insurers, in consideration of a certain premium received by them, either in a gross sum or in annual payments, contract to indemnify the insurer against all loss or damage he [illegible] newed annually by payment of another premium, the company generally allowing fifteen days after the expiring of the year, for the renewing of the policy. As in marine insurance, a misrepresentation, whereby the property insured may be charged at a lower rate of premium than it otherwise would be, invalidates the policy. The party effecting the insurance must also have a *bonâ fide* interest in the property insured. Fire insurances are not in this country subject to the law of average, as in marine insurances; and the amount insured is payable to its full extent, provided the loss or damage is equal to the sum insured. The conditions on which an insurance is granted are in all cases printed upon the policy, and form a part of the contract. A policy of insurance is not in its nature assignable, nor can it be transferred without the express consent of the office. Risks are of various kinds, and are commonly divided into common, hazardous, doubly hazardous, and special. The rate of premium usually charged on common risks is 1s. 6d. per cent., hazardous 2s. 6d. per cent, and doubly hazardous 4s. 6d. per cent. For special risks, the rate is variable, according to the nature of the property, being in some cases as high as 10s. or 12s. per cent., or even higher. It is much to be regretted that such a valuable institution, and one calculated to do so much good, should be subject to a very heavy tax. In 1782, the large amount of business transacted by the insurance offices induced Lord North, then premier, to impose a tax of 1s. 6d. per cent. on the amount of property insured, and this has been increased from time to time until it has reached its present amount. The duty now charged on property insured is 3s. per cent. per annum, besides a stamp duty of 1s. on each policy, which is paid by the company; thus the insured, instead of 1s. 6d. per cent. per annum on ordinary risks, have to pay 4s. 6d. Public hospitals and workhouses, also agricultural produce, farm stock, implements of husbandry, or workmen's tools, not exceeding £20, are exempted from this tax; though why the agriculturist should be thus favoured is difficult to see. The insurance companies have also an interest in not being opposed to the tax, as they are allowed a drawback of five per cent. on the amount for their trouble in collection. The amount

yielded to government by this tax in 1862 was £1,611,681, which gives the immense sum of £1,074,454,000 as the amount of property insured in the United Kingdom, exclusive of farm produce, &c.—*Life Insurance*, or *Assurance*, is a contract for payment of a certain sum in the event of the death of a particular person, in consideration of a premium paid at once or periodically. Assurances are said to be *absolute* when the amount of the assurance is payable on the death of the party assured; *contingent*, when the payment depends also upon some other event; as the existence of some other person or persons at the time of the death. They are also *temporary* when the sum is payable only on the expiry of the life within a certain time; *deferred*, when payable only in the event of the expiry of the life after a certain time; and for the whole life, payable at the death of the individual, whenever that may happen. Assurances are also effected on joint lives under various contingencies. The system of life assurance seems to have been borrowed from the marine, and the pratice at first was for individuals to underwrite life risks in the same way as marine; and this probably existed during the greater part of the 17th century. The Mercers' Company is generally supposed to have been the first to institute a widows' fund, having done so in 1699; and in 1706 the Amicable Society for a perpetual assurance office was started. The Royal Exchange Assurance Company and the London Assurance Corporation were both established in 1720, and the London Equitable in 1762. Soon after this time, a number of other offices sprung up, and at present there are about two hundred of them in England and Scotland. The amount insured in these offices is not known with certainty, but in 1840 it was computed at not less than £150,000,000; while in 1852 the amount insured in Scotland was £34,000,000. There are several kinds of societies; as the proprietary, mutual assurance, and mixed societies. The proprietary, or joint-stock companies, are formed of persons who have subscribed a capital, on the assurance of which the business of the company is carried on, and who divide the profits entirely among themselves. In the mutual assurance societies, on the other hand, there is no proprietary, the assured being likewise the assurers, and dividing the profits among themselves, after deducting the expenses of management, and reserving a guarantee fund. In the mixed class of offices, there is a proprietary, but, at the same time, the assured are allowed to participate largely in the profits of the society, which are usually divided in the form of bonuses at stated periods. The premiums to be paid are adjusted according to the age of the party on whose life the assurance is made; being lowest on young lives, and increasing from year to year as the expectancy of life diminishes. Before effecting an assurance, there are certain forms to be filled up, and certain regulations to be complied with, so as to ascertain the state of health of the proposer; for unless he be in good health, the office will not undertake the risk at the ordinary rate. If the proposer misstates or conceals anything that may affect the rate of premium, it vitiates the policy, though some offices now declare their policies to be indisputable after a certain time. If an assurance is effected by one person on the life of another, the assurer is generally required to prove that he has a sufficient interest in the life to warrant him in taking out a policy to the extent proposed. Most offices will generally lend the value of a policy at a moderate rate of interest on its security. It is also the practice among offices to allow a policy-holder to resign his assurance, and to return him a certain portion of the premiums paid. The sum so returned is generally about one third of the premiums paid and the bonuses declared on the policy. In general, when the insured goes to reside out of Europe, a moderate extra premium is required, varying with the healthiness of the part. On the expiry of the life of the insured, the company requires the production of certain documents; as the register of the burial of the deceased, and references to the medical men and others who attended him in his last illness. It is due to life offices to state that the number of cases where they have disputed claims is very limited. The stamp duties upon policies of assurance is as follows:—Where the sum insured shall not exceed £500, then for every £50, and every fractional part of £50, 6*d.*; where it shall exceed £500 and shall not exceed £1,000, then for every £100, or fractional part of £100, 1*s.*; and where it shall exceed £1,000, then for every £1,000, and every fractional part of £1,000, 10*s.* The expense of the stamp is generally defrayed by the offices.

INTAGLIO, *in-tâl'-yo* (Ital. from *in*, into, and *tagliare*, to cut).—All gems, sculpture, and the dies from which coins and medals are struck, in which the design is hollowed out, or sunk beneath the surface of the stone, are said to be cut in intaglio. Gems and stones cut in intaglio are thus designated to distinguish them from cameos (*see* CAMEO), in which the device is raised in relief above the surface. A cameo, therefore, will give an impression in wax, or any soft substance, in intaglio, while the impression from a seal or signet engraved in intaglio exhibits the device embossed, or projecting in relief from the surface, like a cameo. Thus the terms are used in contradistinction to each other. The art of cutting gems in intaglio must have been practised at a very early age, as we find from Genesis xxxviii. 18, that signets were in use at that period, and Moses was directed to have the names of the twelve tribes engraved on the twelve stones that were set in the breast-plate of the high priest. It was also practised, to a great extent, among the Greeks and Romans, the latter especially being passionately fond of wearing a profusion of engraved gems on the fingers and about their clothing, and making collections of these works of art; while the Greek engravers seem to have excelled in their production, both in beauty of design and excellence of execution. Stones of all sorts, such as agate, cornelian, onyx, jasper, the amethyst, and the garnet, were employed by the ancient engravers for gems in intaglio; but some of the best that are now extant are executed in paste, or gems made artificially. The method of cutting intaglios that was practised by the Greek and Roman engravers, is supposed to be very similar to that which is adopted by the modern seal-engraver, who sinks the design into the stone, by means of finely-pointed cutting-tools, to which a rotatory motion is imparted by a wheel and treadle, as in the turning-lathe. The operation is materially assisted by the introduction of a little diamond dust and sweet oil into the orifice made by the cutting-tool, at various stages of the operation.

INTEGER, *in'-te-ger* (Lat., entire), in Arith., is the name of a whole number, in contradistinction to a fractional number. Thus, in the number 94·7, 94 is an integer, and 7 a fraction, or seven-tenths of a unit.

INTEGRAL CALCULUS, *in'-te-grăl kăl'-ku-lus* (from Lat. *integer*, entire).—As the integral calculus forms one of the most important branches of modern mathematics, and as it is so intimately connected with differentials, it has been deemed best, in the present work, to combine the two in their approximate relationship, rather than to enter upon each separately. A definition of the words, therefore, has been merely given under the headings CALCULUS and DIFFERENTIAL CALCULUS, the subject being fully entered into under the present article. (1) The object of the differential calculus may be stated briefly to be to find the ratios of the differences of certain variable magnitudes, on the supposition that these differences become *infinitely small*; and this hypothesis gives rise to considerable abbreviations in the general calculation of differences. It may be as well here to inquire, Are they all intimately connected with the subject? what are the terms *infinite* and *infinitely small?* It must, however, be first borne in mind, that every magnitude which serves the purpose of mathematical investigation can be augmented or diminished, without any limit as to extent. We may, consequently, imagine a quantity to become so great as to exceed any finite assignable quantity of the same nature as itself, or so small as to be less than any finite assignable quantity as itself: in the former case, the quantity is said to be infinite, and in the latter infinitely small. From these data it may be said that a finite magnitude may be regarded as nothing, or zero, in comparison with one infinitely great, and an infinitely small magnitude as nothing, or zero, in comparison with a finite magnitude. The infinitely

small quantities which come under consideration the differential calculus are called *differentials*; and hence the connection between the terms infinite and infinitely small with the present subject. The following are the principles of the *differential* calculus, and will explain the synonyms which will be made use of in the article. One quantity, u, is said to be a *function* of another, x, when the value of the magnitude of u depends upon the variation of x. Thus, the area of a triangle is the function of the base when the altitude remains unaltered; since the area will increase or decrease with the increase or decrease of the base. If $u = ax^2\ bx$, where a and b are constant quantities, and x a variable one, u is said to be a function of x, since if x changes, the value of u will be altered: this relation ... and u is usually expressed by writing

... The q... dent variable, and u the dependent variable. The differential of a variable may be truly defined to be the infinitely small difference between two successive states of the same variable, and the object of the calculus is to find this differential for all possible cases; that is to say, for all the possible functions of the proposed variables, such as x, y, z, &c., of which the particular differentials are expressed by dx, dy, dz, &c. Before any explanation is entered into as to how this operation is performed, it will be necessary to examine into the distinctions that must be made between the process by which an ordinary, or finite difference, is obtained, and that to which we must have recourse when the difference is infinitely small, or, in other words, is a differential. If we consider the proposed system or function in any two determinate states different from each other, the difference of the two values of the same quantity taken in the two states will be determinate, and consequently cannot be considered as minute as we please, so that no part of its expression can be omitted; but if the two states of the function approach indefinitely near each other, the difference of the two values of the same variable may be rendered as small as we please. It then becomes a differential, and is in fact nothing more than the ordinary difference simplified by the suppression of the quantities which in its expression may be regarded as infinitely small in comparison with the other quantities of which it is composed. Such may be said to be the general principle of differentiation, or, in other words, the manner in which the first differential coefficient A, or $\frac{du}{dx}$, is found. The differential coefficient of the term of any functions equals the sum of the differential coefficients of each function; for, let $u=z+v+w+\&c.$, z, v, w, being functions of x; therefore—

$$u+\frac{du}{dx}h+\&c.=z+\frac{dz}{dx}h+v+\frac{dv}{dx}h+w+\frac{dw}{dx}h+\&c.$$

$$\therefore \frac{du}{dx}=\frac{dz}{dx}+\frac{dv}{dx}+\frac{dw}{dx}+\ \&c.;\ \text{or,}$$

$$\frac{d\cdot(z+v+w+\&c.)}{dx}=\frac{dz}{dx}+\frac{dv}{dx}+\frac{dw}{dx}+\ \&c.;$$

which proves the truth and application of the formula. The utility of these first principles of the differential calculus may be shown by the following problem:—The radius of a circular plate of metal is 12 inches; find the increase of area when the radius is increased ·001 inch.

If u = area of a circle, radius = x

$\therefore u=\pi x^2$; and $du=2\pi x dx$

Make $x=12$, $dx=\cdot001$, then du=increase of area;

$\therefore du=3\cdot1416\times24\times\cdot001=\cdot0753984$ of a square inch.

In the differentiation of angular, exponential, and logarithmic functions, when $u=\sin x\cdot\frac{du}{dx}=\cos x$, or $\frac{d\cdot\sin x}{dx}=\cos x$; when $u=\cos x$, $\frac{du}{dx}=-\sin x$; when $u=\tan x$, $\frac{du}{dx}=\frac{d\cdot\tan x}{dx}=\frac{1}{\cos^2 x}$. Another formula will be found very useful,—that the differential coefficient of the logarithm of a function equals the differential coefficient of the function divided by the function itself.

The primal principle of the differential calculus may be defined to be its application to the equations of curves, by which means the radii of curvation are able to be discovered by a few simple formulas. It also applies to the finding of the maxima and the minima, investigations with regard to sines, and numerous other mathematical inquiries, which, without its aid, could only be solved by the most laborious and difficult methods. It was invented by Leibnitz; and the dispute between him and Newton on the subject of the discovery will be found narrated under the article FLUXIONS. The Integral Calculus is the direct reverse of the differential, its object being to discover the original function from a given relation between the differential coefficients and functions of x and u. The process by which u is formed from $\frac{du}{dx}$ is called integration, and when performed, is expressed by prefixing the symbol $\int x$. Thus, if $\frac{du}{dx}=\phi(x)$, $u=\int x\cdot\phi(x)=C$.

Since $\int$ is the initial letter of *summa*, or sum, the integral is said to be the sum of the differentials of the function. A constant quantity, C, is added, since constant quantities connected with the original function by the sign $\pm$ disappear in differentiation; and therefore, when we return to the original value u, an arbitrary quantity, as C, is added, which must be determined by the nature of the problem. The simplest case to be decided in the integral calculus is when $\frac{du}{dx}=ax^m$. Let $u=Ax^n+C$; $\therefore\frac{du}{dx}=nAx^{n-1}=ax^m$; $a=nA$, and $m=n-1$; $\therefore n=m+1$; and $A=\frac{a}{n}=\frac{a}{m+1}$; $\int_x ax^m=\frac{a}{m+1}\cdot x^{m+1}+C$; or to integrate a monomial, *add unity to the index, divide by the index so increased, and add a constant*. The integrals of the sum of any number of differential coefficients = the sum of the integrals of each differential coefficient. The method usually given for the integration of $\int\frac{1}{x(x^2+1)^n}$ is called "integration by parts," which is very generel in its application, and which may be here explained. Since $\frac{d}{dx}(pq)=p\frac{dq}{dx}+q\frac{dp}{dx}$; $\therefore p\frac{dq}{dx}=\frac{d}{dx}(pq)-q\frac{dp}{dx}$ $\therefore\int_x p\frac{dq}{dx}=pq-\int_x q\cdot\frac{dp}{dx}$. If any differential coefficient can be divided into two parts, one of which is a function of x, as p, and the other is the differential coefficient of a known function of q; then u, the required function, is equal to the product of p and q, *minus* the integral of q multiplied by $\frac{dp}{dx}$. The utility of this method depends upon $q\frac{dp}{dx}$ being less complicated than the original function $\frac{dq}{dx}$. In the integration of the preceding examples, the differential coefficient has either been a given function of one of the variables, or else has been expressed in such terms of the two, that by a very evident process it has been reduced to a function of one only. The next step, therefore, by which we proceed, is to integrate differentials when the differential coefficients and the variables x and y are mingled together. This class of equations, termed *par excellence* "differentials," is divided into minor classes dependent upon the *order* and *degree* of the differential coefficient. Thus, an equation involving $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$, $\frac{d^3y}{dx^3}$, &c. ...... $\frac{d^ny}{dx^n}$ is called a differential equation of the nth order, and of the first degree, while one containing $\frac{dy}{dx}$, $\left(\frac{dy}{dx}\right)^2$, $\left(\frac{dy}{dx}\right)^3$, &c. .... $\left(\frac{dy}{dx}\right)^n$ is said to be of the first order and of the nth degree. The application of these equations may be briefly sketched by the following problem. Find the curve in which the subtangent is equal to the sum of the abscissa and ordinate:—

$$\text{Here } y\frac{dz}{dy}=z+y\text{; and let } u=yz\text{;}$$

$$\therefore \frac{du}{dy}=z+y\frac{dz}{dy}=\frac{z+y}{y}=z+1\text{;}$$

$$\therefore \frac{dy}{ydz}=1\text{;} \quad \therefore \log\left(\frac{y}{c}\right)=z=\frac{u}{y}.$$

Lagrange has worked out three different classes of differential equations, and his theorems on the subject, and the formulas he has laid down for eliminating the integrals, are easy enough for the mathematical student to follow. The *Calculus of Variations* is that which treats on the finding of the maximum and minimum, and also on the nature of the functions which possess that property. This variety of Fluents is merely another form of differentiation under a new symbol, consequently it need not be treated on here. The problems termed isoperimetrical, invented and named by James Bernouilli, come under this latter system. Isoperimetrical figures are such as have equal perimeters, or circumferences. Bernouilli's problems rest on the following question:—"Given the length of a curve, find its equation when the area included by it is a maximum," which can be thus mathematically put:—Find $y=f(x)$, so that $\int_x u$ may be a maximum while $\int_x u_1=c$; which can be easily brought out, and the integral found. The *Infinitesimal Calculus* is the art of employing infinitesimal quantities as auxiliaries, in order to discover the relations which exist among the proposed quantities. The subject will be found treated under the article FLUXIONS (which *see*).—*Ref.* Carnot's *Réflexions sur la Métaphysique du Calcul Infinitésimal*; Hall's *Differential and Integral Calculus*, &c. &c.

INTELLECT, *in'-tel-lekt* (Lat. *intellectus*, from *intelligo*, I perceive a difference, I understand), in Phil., is applied to one of the principal divisions of the human mind, as distinct from the will and the sensational powers. The intellect includes all those powers by which we acquire, retain, and extend our knowledge; as, perception, memory, imagination, judgment, &c. "It is," says Stewart, "by those powers and faculties which compose that part of his nature commonly called his intellect or understanding, that man acquires his knowledge of external objects; that he investigates truth in the sciences; that he combines means in order to attain the ends he has in view; and that he imparts to his fellow-creatures the acquisitions he has made." It is usual to distinguish the intellectual from the moral powers. Aristotle employs the word *nous* for intellect, and uses it in two principal significations,—the one (like reason in its first meaning) denoting, in general, our higher faculties of thought and knowledge; the other, in special, the faculty, habit, place of principles, that is, of self-evident and self-evidencing notions and judgments. Kant distinguishes the intellect into two faculties,—the understanding and the reason. Intellectual knowledge denotes what has its origin in the intellect, in opposition to that which is derived through the senses. Intellectualism, or intellectual philosophy, is applied to a particular system of philosophy which regards the intellect as the only true source of our knowledge, in opposition to sensualism, which regards the senses in that light.

INTENTION, FIRST AND SECOND, *in-ten'-shun* (Lat. *intentio*, having the mind bent on an object), in Log., were terms introduced by the schoolmen to distinguish certain classes of thought. A first intention is a conception of a thing, or things, formed by the mind from external materials, or materials existing without itself. A second intention, on the other hand, is a conception of another conception, or conceptions formed by the mind from materials existing in itself. Thus man, animal, stone, are first intentions, being conceptions formed from external materials; while genus, species, &c., [illegible] second intentions, being formed from first [illegible]ns.—*See* "Review of Whately's Logic," by Sir [illegible]milton, in *Edinburgh Review*, No. 115, or in his [illegible]ions.

INTERCALARY, *in-ter-kăl'-ă-re* (Lat. *intercalarius*, inserted between others), the name that is applied to any day or days that are inserted out of the usual course, for the purpose of preserving the equation of time. The actual length of the year is 365 days 5 hours 48 minutes 50 seconds; but as such a division of time would be attended with inconvenience, as it involves the fractional part of a day, the length of the year was arbitrarily fixed at 365 days of 24 hours each, at the introduction of the Julian calendar, and an intercalary day was, and still is, always inserted in every fourth year, or leap-year, between Feb. 28 and March 1, to compensate for the difference that would arise from neglecting the odd hours entirely, and to bring the sun to the same point in the heavens at the commencement of every period of four years, of which leap-year always forms the last.

INTERCOLUMNIATION, *in'-ter-kol-um'-ne-ai'-shun* (Lat. *inter*, between; *columna*, column), the open area between columns measured by their lower diameters. Upon this important element in architecture depend the effect and proportions of the columns themselves, and the harmony of the whole edifice. There are five kinds of intercolumniation;—*picnostylos*, or columns thick set; *systylos*, having an interval of two diameters; [illegible]*ustylos*, with two and a quarter diameters; *diastylos*, with three diameters; and *aræostylos*, with four diameters, or columns thin set.

INTERCOSTAL, *in-ter-kos'-tăl* (Lat. *inter*, between, and *costa*, a rib), in Anat., is a term applied to certain muscles, vessels, &c., situated between the ribs. There are two sets of intercostal muscles,—the external and internal, which decussate each other like the strokes of the letter X.

INTERDICT, *in'-ter-dikt* (Lat. *interdictum*, prohibition), in the Roman Catholic church, is a mode of censure adopted against a kingdom, province, or town, in consequence of some offence alleged to have been committed by the people or rulers. In terms of this interdict, all kinds of church benefits are denied to such place; there is no church service and no administration of the sacraments. Sometimes, however, the rigour of these interdicts has been mitigated in particular cases, permitting the baptizing of infants, the giving absolution to dying persons, &c. In the middle ages, this was the most terrible blow that could be inflicted upon a prince or people, and had sometimes the effect of throwing a people into a state of rebellion, in consequence of which the prince was compelled to sue for pardon from the pontiff. Interdicts appear to have been first made use of by the bishops in the 9th century; but they were afterwards adopted by the popes. In 998, when Robert of France was married to Bertha, his cousin, Gregory V. interdicted the whole country, and obliged the king to dissolve the union. After a time, they became so common, that they, in a great measure, lost their effect, and fell into disuse. To interdict of fire and water (*interdictio ignis et aquæ*) was a censure pronounced against individuals, and prohibited any one from receiving them or granting them fire or water.

INTERDICT, in the law of Scotland, is an order issued by the Court of Session, or the Sheriff's court, forbidding some act from being done. Usually, before interdict is granted, intimation is given to the opposite party, who gives in answers; but, in pressing cases, an interim interdict is granted on application, before the opposite party has an opportunity of being heard.

INTEREST, *in'-ter-est* (Ang.-Nor., from Lat.), the annual sum or rate agreed to be paid by the borrower of a sum of money to the lender for its use. The sum so lent is called the principal; the sum per cent. agreed on as interest, the rate. The system of lending money on interest seems to have existed from very early times; and Moses has laid down rules regarding it. The Jews were enjoined not to take interest of a fellow-countryman, but were allowed to do so of strangers. Still, however, it seems to have been practised, and the taking of interest, or usury, is frequently condemned in Scripture. In Greece and Rome, too, the system was common. In Greece, the rate of interest not being regulated by law, was generally high, being from 10 to 18 per cent., and upwards. In Rome, during the republic, the rate of interest was excessively high,—sometimes 30 or 40 per cent. In Mohammedan countries, notwithstanding the prohibition in the Koran, the ordinary rate of interest is at least three or four times as great as the ordinary rate in Europe. In England, as in most other countries, after the Conquest, Christians were forbidden, both by

the ecclesiastical and civil law, from taking interest, but the practices of the Jews in that respect were connived at. In 1546, a statute (37 Henry VIII. c. 7) was passed legalising interest to the extent of 10 per cent., as the statutes prohibiting interest [illegible] had so little force. In the reign of J[illegible] ., the [illegible] rate was fixed at 5 per cent., at which it continued till 1839, when all legal restrictions as to rate were abolished. Generally speaking, the rate of interest depends on the profit that may be yielded by its employment in industrious undertakings. "The rate of interest," says Mr. Tooke, "is the measure of the net profit on capital. All returns beyond this on the employment of capital are resolvable into compensations under distinct heads, for risk, trouble, or skill, or for advantages of situation or connection." The rate of interest also varies according to the security for the repayment of the principal and the duration of the loan. If there is any degree of risk as to the repayment of the loan, the rate of interest must necessarily be higher to compensate for that risk; and supposing the security to be equal, capital lent for a fixed and considerable period always fetches a higher rate than that which is lent for a short period, or repayable at the pleasure of the lender. Interest is usually paid yearly or half-yearly; and in this case the loan is said to be at simple interest. Though the payment of interest be not made when it becomes due, no interest can be charged upon the accumulated interest, though it is difficult to see how it should not be so. Thus, if £100 be lent at 5 per cent., and the interest allowed to accumulate for four years, when it would amount to £20, the borrower has had the use of the several interests after they became due as much as he has had of the principal. Sometimes, however, money is so invested that the interest is not paid as it becomes due, but is progressively added to the principal, the two sums together afterwards bearing interest; and this is what is termed compound interest. Interest is reckoned at so much per cent. per annum, that is, so many parts of one hundred annually. Thus, 5 per cent. means £5 of every £100 annually; 4 per cent., £4 of every £100, &c. There are various books of tables for the calculation of interest. In order to find the interest of a given sum at any rate for a year, multiply the sum by the rate of interest, and divide by 100. Thus the interest on £312. 10s. for 3½ years at 4 per cent. is

£312 . 10	£12 . 10
4	3½
12 | 50	6 . 5
20	37 . 10
£	
10 | 00	£43 .. 15

Where there are days in the calculation, they must be treated as fractional parts of a year; that is, the interest for a year must be multiplied by them, and the product divided by 365.—Ref. *Encyclopædia Britannica*; McCulloch's *Commercial Dictionary*.

INTERIM, *in'-ter-im* (Lat., in the mean time), in Eccles. Hist., is the name given to a formulary of faith and discipline drawn up by order of the emperor Charles V., with a view to reconcile the differences existing between Protestants and Roman Catholics. It received its name because it was only a temporary measure, adopted till a general council should decide upon the disputed points. It was mostly in favour of the Catholics, almost the only points conceded to the Lutherans being the marriage of the clergy and the use of the cup in the [illegible]nt of the Lord's Supper. The project pleased neither party; it was condemned by the popes, and rejected by the Lutherans; and, although Charles attempted to force it on his subjects, his efforts signally failed, and the measure was abandoned.

INTERJECTION, *in-ter-jek'-shun* (from Lat. *interjicio*, I throw between), in Gram., is a word used to express some passion or emotion of the mind; as joy, grief, wonder, &c. Interjections have usually been considered, by grammarians, as forming a distinct part of speech, though some regard them as not entitled to this dignity, most of them being nothing more than mere ejaculations.

INTERLOCUTORY, *in-ter-lok'-u-tor-e* (Lat. *inter*, between, and *loquor*, I speak), in Law, is applied to those judgments which are given in the middle of a cause, upon some plea, proceeding, or default, which is only intermediate, and does not finally determine or complete the suit. Of this nature are all judgments for the plaintiff upon pleas in abatement of the suit or action. The term, however, is most commonly applied to those incomplete judgments whereby the right of the plaintiff is indeed established, but the *quantum* of damages sustained by him is not ascertained, which can only be done by the intervention of a jury.

INTERLUDE, *in'-ter-lude* (Lat. *inter*, between; *ludus*, a play), a short play, or dance, accompanied by music, introduced between the acts of a piece, or between the play and the afterpiece. It is not of modern invention. The ancients were acquainted with certain short pieces, loosely connected, which served to make an easy transition from one play to another. Interludes are not so much used now as formerly, when a song or dance, at least, was generally given between every act of a tragedy or comedy. According to Arteaga, modern *interludes* were at first madrigals, which were sung between the acts of a play by several voices, and were connected with the piece. These, however, soon lost their primitive form, and represented some action. Those short pieces of church music seldom exceeding a few bars, and generally produced *extempore*, and played after each stanza, excepting the last of the metrical psalm, to give breathing-time to the singers, are called interludes.

INTERMENT. (*See* BURIAL.)

INTERMITTENT, *in-ter-mit'-tent* (Lat. *inter*, between, and *mitto*, I send), in Med., is applied to diseases which are not continuous, but intermit for a time, and then return again, as in intermittent fevers. (*See* FEVER and AGUE.)

INTERNATIONAL and INDUSTRIAL EXHIBITIONS, *in-ter-nash'-un-al, in-dus'-tre-al* (Lat. *industrius*, diligent; *inter*, between; *natio*, a nation; [illegible] show).—Displays of manufactures and manufacturing art, in which excellence, and not [illegible] merce directly, is the primary object. Industrial exhibitions, in this sense, belong only to the present century, and, in this country at least, have been originated by individuals or societies, independently of any government assistance. The first exhibitions of industry were certainly fairs, which, for many years, have been established in this country. But the displays at those meetings differ from the modern exhibitions; since, at the former, each exhibitor strove to part with his goods to the highest bidder. As early as 1756-57, the Society of Arts in London offered prizes for the best specimens of manufactures,—tapestry, carpets, porcelain, &c., and exhibited the works sent in for competition. About the same period, the Royal Academy, as a private society, patronized by the monarch more in a personal capacity than as representing the head of the legislature, had organized its exhibitions of painting, sculpture, and engraving. The first exhibition of industrial productions in France recognized as a national institution was held in 1798. It remained open three days, and the articles were of an aristocratic and costly, rather than of a popular character. The second exhibition was held in 1801, and the third in 1802, when the exhibitors had increased from 110 to 540; and their productions showed an extraordinary progress in every department. The fourth exhibition was opened in 1806; but it was not till 1819 that the expositions of French industry took place systematically; and it is only since that time that their influence has been markedly felt throughout Europe. In England, "the National Repository," formed at the King's Mews, Charing Cross, in 1828, under the patronage of George IV., with a board of titled persons and the chairmanship of the practical Dr. Birkbeck, failed after three exhibitions, and ended its short career in [illegible] room in Leicester Square. During the last thirty-[illegible] years, however, in each of the principal cities of the United Kingdom, and the most important manufacturing towns, one or more exhibitions of machinery

and manufactures have been held. As early, however, as 1829, the Royal Dublin Society founded an exhibition of works of art, science, and manufactures, to be held triennially; at which, however, Irish productions only were admitted till 1850. But the local exhibition at Birmingham, held in 1849, originating with individuals, self-supporting in its management and comprehensive in the scope of the objects exhibited, may be said to have most resembled the exhibition of 1851. Within two years of the acceptance of the presidency of the Society of Arts by the late Prince Consort, the minutes record several attempts to establish a national exhibition in England. The French exposition 1844 had met with such great success that seve[illegible] representations were made to the cabinet, showing the benefits that would arise from similar exhibitions in the United Kingdom. Efforts were also made to obtain government support to carry out a like object, but without result. In 1848, a proposal to establish a self-supporting exhibition, to be controlled by a royal commission, was submitted to the Prince Consort, who laid it before the government. The Society of Arts petitioned parliament for pecuniary aid, and the Prince Consort warmly supported the cause, imparting to the project a much more magnificent form, by suggesting that the exhibition should be thrown open to the industry of the world. The council adopted his suggestion, and measures were taken for enlisting the sympathies of manufacturers. In all great works of this country, it is a marked feature that they are always the consequences of popular wishes. The idea of an international exhibition of industry at once seized the public mind. Eloquent appeals were made at banquets given at the cities of London and York, and the sentiments there enunciated were re-echoed throughout the country. Public meetings were held in the manufacturing districts, where nearly 5,000 persons registered themselves as promoters of the exhibition. The royal commission was then formed, and the commissioners took the responsibilities. A guarantee fund was formed, the Prince Consort putting his name down for £10,000; and upon the guarantee deed for £230,000, the sum of £32,500 was borrowed from the Bank of England, and afterwards repaid, with interest, out of the receipts at the doors, before the Exhibition had been open three weeks. The royal commissioners then organized 297 district committees, and appointed about 450 local commissioners. Two special travelling commissioners—Dr. Lyon Playfair and Lieutenant-Colonel Lloyd—were appointed to communicate with the local committees; and commissioners were appointed, or committees formed, in eleven British colonies and thirty foreign countries. On the 21st of February, 1850, the commissioners were able to announce the general plan of the exhibition, and to communicate the royal permission to hold it in Hyde Park. The site granted was on the south side of the park, between Kensington Drive and Rotten Row. In March, the building committee appealed to architects and others to assist them with designs for a building. A large number of professional men, both English and foreign, answered the appeal; but the committee finally adopted an entirely new plan, proposed by Sir Joseph (then Mr.) Paxton. The building he proposed was to be constructed entirely of glass, and closely resembled in principle the large conservatory which he had constructed for the duke of Devonshire at Chatsworth. From the first, the plan became popular with the public, and Messrs. Fox and Henderson undertook to erect the building for £79,800, the materials of the building remaining their property. Everything went on smoothly from that time, and on the 3rd of February, 1851, the completed building was formally handed over to the executive committee. The plan of the *Crystal Palace*, as it was called, was cruciform, with a transept, nave, and side aisles. It consisted of a framework of wrought and cast iron, firmly braced together, and based upon a foundation of concrete. In its general form, the building was a parallelogram, 1,848 feet long and 408 wide. About the middle it was crossed by a transept at right angles, 72 feet wide, the semicircular roof of which rose 108 feet, so as to preserve three fine old elm-trees; two other groups of trees caused open courts, which were inclosed within the building. The whole area roofed over was 18½ acres; and [illegible],000 panes of glass were used, most of which were [illegible] inches by 9 in size. The roof was the most novel [illegible] interesting portion of the building; it was su[illegible] the upper tier of girders and trusses; in its [illegible] [le]ngth it was flat, but in detail it consisted of a seri[es o]f ridges and furrows, of moderate rise and fall, and the total length of the gutters was nearly 24 miles. Mr. Owen Jones, well known by his works on the Alhambra, was intrusted with the colouring of the building. The decoration consisted of the scientific application of the three primary colours, red, blue, and yellow, upon narrow surfaces. Its effect was at first much questioned; but it proved admirably artistic and suitable. Within the building, the whole available space was divided into two parts; one half was given to England and her colonies, and the other half to foreign countries. According to the plan laid down by the Prince Consort, the Exhibition had its four great compartments:—1. Raw materials, four classes. 2. Machinery, six classes. 3. Manufactures, nineteen classes. 4. Fine Arts, a class by themselves. The Exhibition was opened by her Majesty on the 1st of May, 1851, in the presence of 25,000 spectators. For 141 days the Exhibition remained open, and during that time the entire number of visits paid to the building was 6,063,986, being an average of 43,111 per day. The estimated value of the articles exhibited, excluding the Koh-i-noor diamond, [wa]s:—

United Kingdom	£1,031,607 4 9
Dependencies of ditto	79,901 15 0
Foreign Countries...............	670,420 11 7
Total.......................	£1,781,929 11 4

The general results of the jury awards were as follows:—Prize medals, 2,918; council medals awarded by juries, 170; "honourable mentions," 2,042; making a total of 5,130 honorary distinctions of all kinds. The whole receipts, from all sources, to Feb. 29, 1852, were £506,000. The greatest number of persons ever present in the building was on Oct. 7th, when 109,915 visited the exhibition. At the conclusion of the display, the balance left in the commissioners' hands, after all expenses had been deducted, was £213,305. 15s. 8d. The success of the Great Exhibition of 1851 naturally led to similar exhibitions in several parts of the world. The building was sold by Messrs. Fox and Henderson to the Crystal Palace Company, and now forms part of the building at Sydenham, which is larger than its predecessor by 1,628 feet, and by nearly one half its cubic contents. In this building, sculpture is picturesquely grouped with luxuriant vegetation. In other portions are spaces set apart for the purpose of illustrating the ethnology, zoology, and botany of different lands. Throughout the building, there are also galleries for the display of objects of industry and fine art; and courts representing the architecture and sculpture of each nation — Egyptian, Greek, Roman, Pompeian, Alhambra, Assyrian, Byzantine, and Romanesque; German, English, French, and Italian medieval; Renaissance, Elizabethan, Italian, &c. The Crystal Palace is placed at the head of a landscape garden and park, designed by Sir Joseph Paxton. After the Exhibition of 1851, the more immediate results were the Cork Exhibition of 1852, and in the next year the Universal Exhibitions in Dublin and New York, both in buildings constructed of iron and glass. The result of the former, however gratifying in many ways, was far from being a financial success, seeing that a heavy loss fell on Mr. Dargan, a wealthy and liberal railway contractor, who had generously advanced large sums of money to further the scheme. The New York Exhibition was also a failure; the choice of the locality was bad, and the area to be built on was only 450 feet square; far too small for the object in view. The building ought to have been open on the 1st of May, 1853, but it was not till the 14th of July that it was really opened; thus seriously limiting the number of summer days when it could be open. This delay was disappointing to the public and the exhibitors, and disastrous to the company. It remained open 119 days; the receipts during that time were £71,000, and the final cost for everything was little short of £300,000; absorbing all their share capital, all the receipts from visitors,

and two loans raised at interest. In 1855, the twelfth exhibition in Paris followed. This was the first great French international exhibition, and the plan of the Exhibition of 1851 was closely followed in it. The whole cost was borne by the government, and the management was intrusted to special commissioners, appointed by the emperor. One of the points of difference between the Paris and London exhibitions, was the admission of paintings and engravings into the former. There were four classes of medals distributed, and one grade of "honourable mention." In 1857, the Manchester Art Treasures Exhibition took place. It was an exhibition solely of artistic objects, sent by their possessors, and not by their producers or dealers. The scheme was favourably received, and an ample guarantee fund provided. The Queen and the Prince Consort gave their hearty support to the undertaking, and the owners of works of art cheerfully and freely responded to the appeal. 1,115 paintings of all kinds by ancient masters, and 689 by modern masters, were exhibited. The pictures by ancient masters were arranged chronologically; and for completeness and value, such a collection was probably never brought together before. The exhibition remained open for five months, during which period it received over a million and a quarter visitors. The Italian National Exhibition at Florence, and the Turkish Exhibition at Constantinople, in the year 1863, were steps in the same direction as the Exhibition of 1851. The result of the first International Exhibition in England was such as to leave a surplus or profit, which promised to be the nucleus of fut important operations.. In order to apply this money properly, and keep faith with the subscribers to the fund, the royal commissioners applied to her Majesty for a supplemental charter, which being granted, empowered them to dispose of the surplus as they might think fit. The first proposal was to form a "Trade Museum," in which were to be stored articles presented to them by the exhibitors in 1851. The Gore House estate was purchased for this purpose, and £60,000 were paid for it out of the surplus fund. In extent, this property comprised about twenty-one acres; and to it were added several nursery-gardens and market-grounds, together with Cromwell House, and other lands belonging to the earl of Harrington and the baron de Villars. Government supplied other funds, and entered into a sort of partnership with the commissioners, by whom eighty-six acres in all were purchased for £280,000. The object of these purchases of land was to secure a large space to which some of the national exhibitions might be removed. In 1858, however, the commissioners dissolved partnership with the State; the sums advanced by government were repaid by the commissioners, subject to a deduction for the ground and buildings of the South Kensington Museum, now a government institution in connection with the department of Science and Art. Since that time, the commissioners are stated to have nearly doubled their original capital. The international character of industrial exhibitions assumed greater importance with the Society of Arts after each of the displays following the Crystal Palace of 1851. It was considered desirable to hold such an exhibition periodically. At first, the year 1861 was chosen; but, on account of the Italian war and the disturbed state of the continent generally, it was ultimately postponed till 1862. By a guarantee agreement, in the case of a loss by the exhibition, each subscriber was to contribute in rateable proportion to his subscription. Earl Granville, the marquis of Chandos, Mr. Thomas Baring, and Mr. Dilke, consented to be the trustees for the exhibition. The next proceedings were as follows, according to the *Quarterly Review*, vol. cxii., No. 223. "The steady-going Society of Arts was now called in, and a very odd triangular arrangement consummated. The commissioners of 1851 leased to the Society of Arts the desired plot of ground for ninety-nine years, in order that a third body, viz., the commissioners of 1862, might cover the ground with an additional building. Of this building, one part was to be considered temporary, and either to be reckoned the property of the contractors, after a vast royalty had been paid for its use, or else bought out-and-out for a further sum; and the other part was to be held permanent, and to pass for the term of the lease of the Society of Arts, supposing the speculation to be solvent. If the returns were insufficient, this portion was to be pulled down at the close of the exhibition. The motive power of the whole scheme was a solid phalanx of Englishmen, some of them men of capital, and some men of enterprise, who had from various motives subscribed a deed of guarantee to the amount of several hundred thousand pounds, and on the strength of this deed, the Bank of England found the money for the immediate undertaking. So there were the bank that advanced, the subscribers who guaranteed, the new commission that managed, the Society of Arts that advised and that waited for its windfall, and the old commission that sat in its counting-house counting out its money." The list of guarantors was headed by the Prince Consort with a subscription of £10,000. After a site had been determined upon, the queen granted a charter to the trustees in February, 1861; and a design for a building by Captain Fowke, of the Royal Engineers, was declared to be accepted. The principal feature of this design consisted at first of a great central hall, with an arched roof and rounded ends, 500 feet long, 250 feet wide, and 210 feet high. The estimates for the original structure, including this hall, amounted to £590,000. Messrs. Kelk and Lucas having sent in the lowest tenders for a modified form of this building, were appointed contractors for the work, and the building was to be completed by the 12th of February, 1862. The work of constructing the exhibition building may be said to have been begun at the beginning of April, 1861, and to have been practically finished about the beginning of April, 1862. The main building then occupied about sixteen acres of ground; it was nearly rectangular in shape, being 1,200 feet from east to west and 560 feet from north to south. Its situation was south of the Horticultural Society's gardens and the Kensington road. The whole ground was covered with permanent buildings; and two long strips of ground, east and west of the gardens, were roofed in by temporary sheds called "annexes," in which were displayed machinery and large and heavy objects. Within the permanent structure, the space was covered in by roofs of various heights, and divided into nave, transepts, aisles, and open courts; the roofs of the latter were of glass, but the others had opaque roofs with clerestory windows. The most particular features of the building externally were two huge domes at the east and west fronts, each rising to the height of 260 feet. In the appropriation of the several portions of the building, the naves, transepts, galleries, and courts were devoted to the display of industrial productions; the brick building on the north, inclosing the narrower court, for refreshments; and the grand picture-galleries extending along the south side, with auxiliary wings in front of the east and west transepts. To Mr. Crace was intrusted the decoration of the entire building; and although his plan met with some severe criticism, it was generally admitted that the decorations not only gave lightness to a building naturally heavy, but in some portions were grand, harmonious, and rich. Upon the national and local committees devolved the task of allotting the space and selecting the articles to be sent for exhibition. The classification was based on that of 1851, and embraced thirty-six classes, besides those of the fine arts. By an extraordinary effort of labour, the executive committee were enabled to open the exhibition on the 1st of May, 1862. But on this occasion there was not the same brightness and splendour which had attended the ceremonial of 1851. The Prince Consort, by whom the great work of the day had been encouraged and helped on, was dead, and a deep gloom seemed to hang over all the proceedings. In the absence of her Majesty, the building was opened with great state and ceremonial by the duke of Cambridge. After remaining open for six months, the exhibition was closed on the 1st November, 1862. The total number of visitors, excluding the staff and exhibitors' attendants, was 6,117,450, or 87,000 over the gross numbers in 1851. The jurors and their associates engaged in examining the objects of the exhibition amounted to 612 persons, of whom 287 were foreigners and 325 English; and the number of exhibitors whose objects they had to examine was 25,000. Nearly 7,000

medals were voted by the juries, and 5,300 "honourable mentions." Altogether the exhibition of 1862 was successful, although the Commissioners had to contend with very great and numerous difficulties. The loss of the Prince Consort might be considered as irreparable in so far as regards the organisation of international exhibitions of artistic and industrial products. The International Exhibition held in Paris, in the year 1867, attracted the contributions of the chief manufacturing firms of Europe and America. In the year 1871 there was opened, on the 1st of May, the first annual International Exhibition of London. The charge for admission on Wednesdays was two shillings and sixpence, on other days one shilling. The total number of visitors by payment amounted to 1,039,186. The visits of season-ticket holders raised the gross total to 1,142,154. The financial success of this exhibition enabled the Royal Commissioners to devote the sum of £2,000 to the purchase of selected articles for the nation.—*Ref.* Timbs' *Year-Book of Facts*, 1851, 1862, 1867, 1871, and 1872; also the reports respecting the respective exhibitions.

INTERNATIONAL LAW. (*See* LAW.)

INTERNUNCIO, INTERNUNTIUS, *in-ter-nun'-she-o*, *in-ter-nun'-she-us* (Lat. *internuncius*), is generally a messenger between two courts or governments, and more particularly applied to a representative of the pope, sent to small states and republics, as distinguished from the nuncio, who represents the pope at the courts of kings and emperors.

INTERPLEADER, *in'-ter-ple'-der*, in Law, is a proceeding in a suit where a person owes a debt or rent to one of the parties, but, till the determination of it, he does not know to which. He accordingly desires that they may interplead, so that he may be safe in the payment; in which case it is usual to order the money to be paid into court, for the benefit of such of the parties as the court, upon hearing, shall decree it to be due. Formerly, recourse was almost always had to a court of equity, but by stat. 1 & 2 Will. IV. c. 58, it is enacted, that upon application of a defendant sued in the courts of law, in any action of assumpsit, debt, detinue, or trover, showing that the defendant does not claim any interest in the subject matter of the suit, but that the right thereto is claimed, or supposed to belong to some third party, the court may make an order on such party to appear and state his claims; and powers are given to the court to direct an issue to try the same.

INTERPOLATION, *in-ter-po-lai'-shun* (from Lat. *interpolo*, I place between), a term applied in Alg. and Astron. to a method employed for filling up the intermediate terms of a series of numbers or observations, by numbers which follow the same law. The method itself is dependent upon the following problem:—Let there be given two series of numbers, the corresponding terms of which have some determinate relation to each other, and of which the first is called the series of roots, and the second the series of functions (*see* INTEGRAL CALCULUS); to find the function corresponding to any term in the series of roots, from the numbers in the series of functions, which precede or follow that which is required, this is a question of *interpolation*. In other words, its application may be shown as follows:—The most extensive table of logarithms in common use is a succession of values of log. x, answering to $x = 10,000$, $x = 10,001$, $x = 10,002$, and so on up to $x = 99,999$. The process of interpolation is that of inserting in a table values of the tabulated function, intermediate to those given in the table. For example, suppose that p, q, r, s, &c., are written in a table opposite to a, $a + b$, $a + 2b$, $a + 3b$, &c., if it is demanded what is the value of the function corresponding to $a + 2\frac{1}{2}b$, it would be a question coming under the heading interpolation. In astronomy, also, it teaches us a mathematical law which will connect together a number of observed facts. Thus, supposing that twenty places of a comet have been determined by observation, these places are said, in mathematical language, to be interpolated when a curve, defined by an analytical equation, has been formed, which passes through them all; for, by means of this curve, the point of location of the comet at any intermediate time can be easily discovered.—*Ref.* Lacroix's *Differential and Integral Calculus*, translated by Sir John Herschel; also Newton's *Principia*, 3rd Book. (*See* also articles GEOMETRY and INTEGRAL CALCULUS.)

INTERPOLATION, in Philological Criticism, signifies the insertion of spurious passages in a work. In some printed texts, passages that are suspected of not being genuine are often inclosed in brackets.

INTERREGNUM, *in-ter-reg'-num* (Lat. *inter*, between; *regnum*, kingly government), is the period during which a throne is vacant, the interval between the death of one king and the accession of another.

INTERREX, *in'-ter-reks* (Lat. *inter*, and *rex*, a king), a person usually appointed to discharge the functions of royalty during a vacancy on any throne. The Romans were the first people who had an interrex, and they appointed one after the death of Romulus. An interrex was also sometimes appointed under the Republic, to preside over elections of magistrates and other officers, when the consuls were absent.

INTERROGATION, *in-ter-ro-gai'-shun* (from Lat. *interrogo*, I question), the act of questioning, also a note in writing and printing, which marks a question being put, thus (?).

INTERSECTION, *in-ter-sek'-shun* (from Lat. *inter*, and *seco*, I cut), a term applied in Geom. to the point of meeting, or function of lines or surfaces. The intersection of two lines, or of a plane and a line, is a point, and the intersection of two surfaces is a line. (*See* GEOMETRY.)

INTERVAL, *in'-ter-val* (Lat. *intervallum*, space between things), in Mus., the difference in point of gravity or acuteness between any two sounds. By the ancients, intervals were divided into simple, or uncomposite, and composite; the first of these they termed *diastems*, and the second, *systems*. According to Bacchius, the enharmonic diesis, or fourth of a tone, was the least of all the intervals in the Greek music; but as all our tones concur in consonances (to which order only the *diatonic* of the three ancient genera was accommodated), our scale does not notice so small a division. In modern music, the semitone is considered as a simple interval; thus from B to C is a semitone, or simple interval, and only those which consist of two or more semitones are termed composite, as from C to D, which is two half-tones, or a compound interval.

INTERVENTION, *in-ter-ven'-shun* (Lat. *inter*, and *venire*, to come between), in Pol., a word used to express the armed interposition of one state in the domestic affairs of another. Since the congress of Vienna, this right of intervention has become distinctly recognized, and has been acted upon more frequently than formerly. The right of every nation to increase its national dominions, wealth, and power, by all innocent and lawful means, is an incontrovertible right of sovereignty, generally recognised by the usage and opinion of nations; but when the exercise of this right directly interferes with the sovereign rights of other states, then the right of intervention, or interference of other states, is requisite to preserve the balance of power. As is rightly observed in Wheaton's "International Law," the internal development of the resources of a country, or its acquisition of colonies and dependencies, at a distance from Europe, has never been considered a just motive for such interference. Interventions, therefore, to preserve the balance of power, have been generally confined to preventing a sovereign, already powerful, from incorporating conquered provinces into his territory, or increasing his dominions by marriage or inheritance, or exercising a dictatorial influence on the councils and conduct of other independent states.

INTESTACY, *in-tes'-ta-se* (Lat. *in*, not, and *testor*, I testify), in Law, denotes the dying without having made a will.

INTESTINAL WORMS, *in-tes'-ti-nal* (Lat. *intestina*, an intestine), a class of animals which infests the interior of other animal bodies, and, as its name implies, especially the intestinal tube. All animals seem destined to be preyed on by others, not only after death, but during life. The frequency of worms in the bodies of human beings, as well as of the lower animals, their

them objects of interest in physiology and from a very remote time. Yet, though so long

frequently investigated, the science of Helminthology (Gr. *helmins*, a worm; *logos*, a discourse), or the natural history of worms, has only made great progress in the last half-century. There is scarcely any disease which has not at some time been attributed to worms. The entozoa, or intestinal worms, form a family, or class, of the sub-kingdom of Zoophytes. Rudolphi introduced the term entozoa into the language of natural history; and the word has been adopted, not only in this country, but also in France and Germany. It includes all those animals which naturally and permanently inhabit the intestines, or any other internal part of animal bodies. These creatures do not, however, infest every animal indiscriminately; on the contrary, the parasites of nearly every species are peculiar to itself, or they are confined to a few, the habits and structure of which are analogous. The reasons which determine these parasites to select individual animals are unknown; but it would appear that worms generally infest the delicate and sickly; that in some cases youth seems to favour their production, and in others maturity. In human beings, the use of a crude farinaceous diet has been much blamed; yet the poor of Scotland, who subsist mostly on food of this sort, are not more troubled with worms than the poor of England. The generation of an intestinal worm, called the *fluke*, in sheep and cattle, is said to be favoured by rich moist pastures. Salt pastures, on the contrary, are said to be destructive to the fluke and worm. According to Dr. Paris, "salt, when taken in moderate quantities, promotes, while in excessive ones, it prevents digestion: it is therefore tonic and anthelmintic, correcting that disordered state of the bowels which favours the propagation of worms." Lord Somerville also adduces an instance of the results of the want of salt, a punishment formerly existing in Holland. "The ancient laws of that country ordained men to be kept on bread alone, unmixed with salt, as the severest punishment that could be inflicted upon them in their moist climate. The effect was horrible: those wretched criminals are said to have been devoured by worms engendered in their own stomachs." Although intestinal worms are found principally in the alimentary canal and the viscera subservient to its functions, they are, however, not confined to this portion of the body. Some species have their appropriated seats in the cellular, adipose, and serous tissues, and in the parenchyma of the most secret organs. One species is found in vast numbers in the voluntary muscles, and more than one has penetrated the heart. Several are developed in the brain, the lungs, and air-passages, the liver, and the kidneys; one or more have entered the blood-vessels, or tumours connected with them; others are to be found in the humours of the eye, and several species in the urinary secretions. The variety of external form in all intestinal worms is sufficiently great to form the basis of their classification into five subordinate divisions. 1. Nematoidea (Gr. *nema*, a filament; *eidos*, a form): round worms. The body of these worms is cylindrical and elastic, with the intestinal tube terminated at one end by the mouth, at the other by an anus: the sexes are separate. 2. Acanthocephala (Gr. *acanthos*, a thorn; *cephale*, a head): hooked worms. Their characteristics are,—a roundish body, utricular and elastic; proboscis retractile, armed with spiculæ arranged in rows; sexes distinct. 3. Trematoda (Gr. *trema*, a hole): fluke-worms. Their characteristics are,—a flattish soft body, of various forms, often tending to oval; one or more pores on its under surface. They have no intestinal canal, and the organs of generation of the two sexes co-exist in the same individual. 4. Cystoidea (Gr. *kestos*, a band; *eidos*, a form): tape-worms. These parasites have a soft elongated body, flat like a riband, in some continuous, in others articulated; the head is either only simply labiated, or provided with pits, or with two or four suctorious orifices. There is no trace of an intestinal canal, and the male and female organs are present in each individual. 5. Cystica (*kustis*, a bladder). hydatids (which *see*). The characteristics of these worms are,—a flattish, or rounded body, terminating posteriorly in a transparent bladder-like cyst, filled with a pellucid fluid, which is sometimes common to many individuals; head provided with two or four pits, or with four suckers, and with a circle of booklets, or with four unarmed or uncinated tentacles. The sexual organs have been hitherto undiscernible.

INTESTINES, *in-tes'-tins* (from Lat. *intus*, within), in Anat., is that part of the alimentary canal which extends from the stomach to the anus, and is situated in the cavity of the abdomen: the entire length of the intestinal canal is about six times that of the body. It is composed of three coats, or membranes,—the peritoneal, the muscular, and the villous. It is divided into the small and large intestines. The small intestines have three divisions,—the duodenum, so called from its length being about twelve finger-breadths, and which commences at the pyloric end of the stomach; the jejunum, so named from being generally found empty; and the ileum. The large intestines have likewise three divisions,—the cæcum, colon, and rectum. Each of the parts will be found described separately under their own names. The small intestines have internal membranous folds, called *valvulæ conniventes*; while the large intestines have three strong muscular bands, which run parallel upon the surface.

INTONATION, *in-to-nai'-shun* (Lat. *intono*, I utter a sound), the art of tunin[illegible] voice, or instruments, that occasional impulse, swell, and decrease, upon which all expression, to a great extent, depends. The intonation of a singer may be true or false, according to the observance or non-observance of the just proportions that belong to the intervals sung. True intonation is an exception amongst singers, and among players upon bowed instruments, such as the violin, violoncello, &c. In church music, those antiphonies which are first sung by the priest and then responded to by the choir or congregation, are called *intonations*.

INTOXICATION, *in-toks-e-kai'-shun* (Lat. *in*, and *toxicum*, a poison), the state produced by the excessive use of alcoholic liquids or inebriating substances. In general, intoxication comes on gradually, and several stages may be noted in its progress. Thus, it shows itself at first by a general liveliness and excitability; during this stage, the circulation of the blood [illegible] more rapid, and all the functions of the body are performed with more freedom. No surcharge of blood, however, is produced, either in the head or lungs, by the excitement. While in this condition, indeed, the mental powers seem to act more freely; the imagination is stimulated, the fancy is more lively, and the feeling of strength and courage is increased. The effect on the brain is much more decided in the second stage of intoxication. Then, all the peculiarities of character, the weaknesses and failings of temperament which the individual can keep under and conceal in his sober moments, manifest themselves. Consciousness begins to be attacked, secret thoughts and the sense of propriety are lost. The peculiarities of this stage are summed up in the old proverb, *in vino veritas*, "in wine there is truth." In the next stage, consciousness is still more weakened, the balance of the body cannot be kept, the sight becomes confused, and the brain dizzy. After this point, the mind seems to be entirely overwhelmed by the tumult of animal excitement, consciousness is utterly extinguished, the tongue can only mutter incoherent gibberish, the face becomes suffused with blood, the eyes protrude, and perspiration streams from the pores of the skin. Lastly, when completely prostrated, the victim of intoxication sinks into a heavy slumber, closely resembling the stupor of an apoplectic fit. (*See* TEMPERANCE.)

INTRADOS, *in-trai'-dos* (Lat. *intra*, within; *dorsum*, back).—The outline or curve formed by the junction of the lower ends of the voussoirs of an arch is called its intrados or soffit; while the curve similarly formed by the upper ends of the voussoirs is termed its extrados.

INTRANSITIVE, *in-trän'-si-tiv* (Lat. *intransitivus*, passing over).—In Gram., an intransitive verb is one which expresses an action or state that is limited to the agent, or, in other words, an action that does not *pass over* to, or operate upon, an object.

INTRENCHMENT. (*See* LINES OF INTRENCHMENT.)

INTRIGUE, *in-treeg'* (from Ital. *intrigo*), an assemblage of events or circumstances which occur in any affair, and lead to the perplexity of the persons acting therein. In this sense it is used to signify the plot of a play or romance, or that point in which the principal characters

are most embarrassed, through artifice or through unfortunate accidents and incidents.

INTRUSION, *in-tru'-zhun* (Lat. *intrudo*, I thrust upon), in Law, is the entry of a stranger, after a particular estate of freehold is determined, before him in remainder or reversion. It happens where a tenant for term of life dies seised of certain lands and tenements, and a stranger enters thereon after such death of the tenant, and before any entry of him in remainder or reversion.

INTUITION, *in-tu-ish'-un* (Lat. *intueor*, I behold), in Phil., is applied to that power of the human mind by which a thing is known or comprehended immediately, as soon as it is perceived or attended to. When the mind perceives the agreement or disagreement of two ideas, immediately by themselves, without the invention of any other, this is intuitive; for in this the mind is at no pains of proving or examining, but perceives the truth, as the eye does the light, only by being directed towards it. Thus, the mind perceives that white is not black, that a circle is not a triangle Things that are known by intuition cannot be made more certain by arguments than they are at first. Axioms are propositions known by intuition. "Intuitive knowledge," says Sir W. Hamilton, "is complete and perfect, as affording the highest certainty of the highest determination of existence, the actual, the here, and the now existent; representative, incomplete and imperfect, as affording only an inferior assurance of certain inferior determinations of existence,—the past, the future, the possible,—the not here and not now existent."

INULA, *in'-u-la* (its Latin name), in Bot., a gen. of the nat. ord. *Compositæ*, consisting of numerous species, found in every part of the world. The root of *I. Helenium*, or elecampane, one of the largest of British herbaceous plants, yields a starch called *inulin*, which has been used medicinally from the time of Hippocrates. It is an aromatic, tonic, expectorant, and diaphoretic, and has been prescribed in chronic catarrh and in dyspepsia.

INULIN. (*See* INULA.)

INVARIABLE. (*See* VARIATION.)

INVECTED, *in-vek'-ted* (Lat. *in*, into, and *vehere*, to carry), one of the eight partition lines used in heraldry. It resembles the line termed "engrailed" in form (*see* ENGRAILED), as it consists of a series of semicircular or scolloped indentations; but it differs from it in having the points of the indentations turned inwards and projecting into the charge, instead of into the field of the shield.

INVENTION and DISCOVERY, *in-ven'-shun*, *dis-kuv'-e-re* (Lat. *invenio*, I find out; Fr. *découvrir*, literally, to uncover, lay open what was before concealed).—Invention is the creation or construction of something which has not before existed; discovery is the making manifest something which has hitherto been unknown. Galileo invented the telescope; Harvey discovered the circulation of the blood. In older times, however, this distinction was not observed, and the two terms were used synonymously; thus Locke and Bacon talk of the invention of sciences. The rights of individuals to the honour due to inventions or discoveries are matters of constant discussion in the history of letters and science, and the subject is as yet but little understood. (For a long and interesting article on the subject, we would refer to the *English Cyclopædia*—Arts and Sciences.) It is a very remarkable fact that not unfrequently discoveries are made by more than one person at the same time.

INVENTION OF THE CROSS, the name of a festival celebrated by the Roman Catholic church on the 3rd of May, in honour of the finding of the cross on which Christ suffered, by the empress Helena, mother of Constantine, A.D. 326.

INVERSE PROPORTION. (*See* PROPORTION.)

INVERSION, *in-ver'-shun* (Lat. *inversio*, change of ... in Rhet., is the placing of words out of their order. In every language there is a certain ...ary arrangement observed in the ordering of ... in a sentence. In English the order generally is, first the nominative, then the verb, and afterwards the accusative, if the verb be active. This order, however, is, for the sake of effect, frequently varied; as in the sentence "Great is Diana of the Ephesians," which is infinitely more forcible than "Diana of the Ephesians is great." In this respect, the Latin language admits of much more liberty than ours does. Milton, in his prose works, and some of the older English writers, in attempting to imitate this, produced obscurity.

INVERSION. (*See* INTEGRAL CALCULUS.)

INVERTEBRATA, *in-ver-te-brai'-ta* (Lat. *in*, not; *vertebra*, a joint of the backbone), in Zool., is a negative term, first employed by Lamarck to designate animals destitute of a vertebral column or backbone. The Invertebrata constitute three out of the four great divisions of the animal kingdom; viz., Articulata, Radiata, and Mollusca. (*See* VERTEBRATA, or ANIMAL KINGDOM.)—*Ref.* Professor Owen's *Lectures on the Invertebrate Animals*.

INVESTITURE, *in-ves'-ti-ture* (Fr.), in the Feudal Law, was the actual conveyance of feudal lands by a lord to his vassal. According to Mr. Hallam, it "was of two kinds,—proper and improper. The first was an actual putting in possession upon the ground, either by the lord or his deputy, which is now called, in our law, livery of seisin. The second was symbolical, and consisted in the delivery of a turf, a stone, a wand, a branch, or whatever else might have been made usual by the caprice of local custom. Du Cange enumerates no less than ninety-eight varieties of investitures." Investitures were introduced at a time when the art of writing was but little known, and by the open and notorious delivery of possession in the presence of the other vassals, who, in case of a disputed title afterwards, might bear witness to the fact.

INVOCATION, *in-vo-kai'-shun* (Lat. *invoco*, I call upon), in Lit., is applied to that part at the commencement of a poem in which the poet calls upon the Muses, or some one capable of giving him inspiration, to aid him in his labour.

INVOCATION OF SAINTS, in the Roman Catholic church, is the calling upon or praying to the saints that they intercede with God for men. The invocation of saints is believed to have been introduced as early as the 4th century, and it soon became general in the Church. In the creed of Pius IV. it is said "that the saints reigning together with Christ are to be honoured and invocated, that they offer prayers to God for us;" and in the catechism of the council of Trent they are said to be invoked "because they always see the face of God, and are constituted by him the willing advocates of our salvation."

INVOICE, *in'-voys* (Fr. *envoi*), is a list or account of goods or merchandise sent by merchants to their correspondents, giving the quantity, value, &c. of the several articles.

INVOLUCRE, *in-vo-lu'-kr* (Lat. *involucrum*), in Bot., a whorl of bracts placed round the base of an umbel, a capitulum, or sometimes a single flower. In some umbelliferous plants,—as, for instance, the carrot,—there are two kinds of involucre, one at the base of the primary divisions of the floral axis or general umbel, and another at the base of each of the partial umbels or umbellules: the former is then called the *general involucre*, and the latter an *involucel*, or *partial involucre*. In the involucres of the heads of flowers in the nat. ord. *Compositæ*, such as the marigold, daisy, &c., there are frequently two or three rows of bracts overlapping each other. To these overlapping bracts the term *phyllaries* has been applied. (*See* BRACT.)

INVOLUTE CURVE, *in'-vo-lute* (Lat. *involutio*, unfolding), in Geom., a curve supposed to be described by the extremity of a string unwinding itself from another curve (evolute) about which it has been rolled.

INVOLUTION and EVOLUTION, *in-vo-lu'-shun*, *ev-o-lu'-shun* (Lat. *involuto*, I enwrap, enfold), in Math., two distinct operations, one of which is the reverse of the other. *Involution* consists in raising the power or index of a number by multiplying it successively into itself. Thus, to raise 4 to 4^3, or 64, is a process of involution, and is performed by multiplying 4 by 4, and again by 4. Involution in algebra is exactly the same as in arithmetic, symbols only being used instead of figures. *Evolution* is the reverse of involution, and consists in finding the original power of the number from the index to which it has been raised; and the method of the operation will be found given under the separate articles entitled CUBE ROOT and SQUARE ROOT respectively.

IODIC ACID, *i-od'-ik* (from iodine), in Chem., symbol

IO_5, equivalent 167. Iodic acid corresponds in com-... to chloric and bromic acids. It is prepared in several ways, the best perhaps being that of M. Millon. Equal parts of iodine and chlorate of potash are mixed in five parts of water. Chlorine is evolved, and iodate of potash remains dissolved in the water. Chloride of barium is next added, which yields an abundant precipitate of iodate of baryta, which is sparingly soluble in water. It is washed and just enough sulphuric acid is added to it to combine with the baryta. The iodic acid dissolves in the water, and sulphate of baryta is precipitated. The iodic acid may be obtained in crystals of the formula IO_5HO, by careful evaporation. By a heat of 460° it is rendered anhydrous, and at about 700° it is decomposed into iodine and oxygen. Dissolved in water, it forms a colourless inodorous solution. Organic bodies decompose it, owing to which circumstance litmus-paper is first bleached, and then reddened by it. It forms with different bases three classes of salts, containing one, two, and three equivalents of acid. Thus with potash it forms the iodate, biniodate, and teriodate. The iodates have as yet received no important application.

IODINE, *i'-o-dine* (Gr. *iodes*, violet-coloured), in Chem., symbol I, equivalent 116·8, combining volume 2, spec. grav. of vapour 8·716. Iodine was discovered by Courtois, in 1811, in the waste liquors produced in the manufacture of soda from sea-weed. It is contained in nature, principally in sea-plants and sea-water, in the forms of iodide of sodium, potassium, and magnesium. It also occurs combined with silver in *iodite*, a mineral found sparingly in Peru. The great source of iodine is burnt sea-weed, commonly known as kelp. It is largely manufactured at Glasgow from kelp made on the Scotch and Irish coasts. The following account of the method of manufacture is taken from Graham's "Elements of Chemistry." The sea-weed having been dried in the sun, is burned in shallow excavations at a low heat. Owing to the volatility of the iodide of sodium at a red heat, the loss of this salt would be considerable if the temperature were raised too high. The half-fused ash, or kelp, which remains is broken into fragments and treated with boiling water, which dissolves about one half the ash. The liquid thus obtained is then evaporated in shallow pans, and all that can be separated by crystallization is removed: sulphate of soda, carbonate of soda, and chloride of potassium are thus extracted. The iodine remains in the mother liquor, in company with the sulphide of sodium and some other salts. Oil of vitriol is now mixed with the mother liquor, and the mixture allowed to stand. The supernatant liquor is then decanted, heated in a retort to about 140°, powdered binoxide of manganese being introduced. The temperature is then raised, care being taken not to reach 212°, when the iodine distils over and forms crystals in the receiver, which are resublimed several times, in order to purify them. Iodine generally occurs in commerce in the form of bluish-black scales having a metallic lustre somewhat resembling plumbago. By carefully-conducted sublimation, it may be obtained in rhombic plates an inch long. At ordinary temperatures, it is volatile, emitting an odour closely resembling chlorine, but somewhat weaker. Its specific gravity is 4·947. It fuses at 250°, and boils at 347°, giving forth a magnificent violet vapour, from which it derives its name. Taken internally, in large doses, it is a violent poison, but in small quantities, it is much employed in medicine to remove glandular swellings and goitres. It turns the skin, and most organized bodies, a deep brown, corroding them, if present in large quantities. Water dissolves only a small quantity, which gives the solution a yellow colour. Its bleaching properties are feeble. Alcohol, ether, and solutions of the iodides, dissolve it freely. Iodine attacks the metals freely, iron or zinc being dissolved if placed with it in water. The compounds of iodine with the metals are decomposed by chlorine. Iodine forms a blue compound with starch, a property used as a test to determine the presence of either body. By its means, one part of iodine dissolved in one million of water, may be discovered. An improved method of obtaining it from sea-weed has lately been patented by the inventor, Mr. E. C. C. Stanford. Instead of allowing the weed to dry on the shores where it is found, Mr. Stanford compresses it into cakes while it is wet, and afterwards dries them by artificial heat. The dried cakes are then submitted to destructive distillation; ... Mr. Stanford not only gets double the ... of iodine, none being lost by heat or washed away by rain; but, in addition, he obtains gas for illuminating purposes, various oils, besides the charcoal left in the retorts. The principal compounds of iodine are iodic acid, hydriodic acid (which will be found described under their respective headings), and the chloride and bromide of iodine. With chlorine, iodine forms two compounds,—the protochloride, a deep brown deliquescent liquid, obtained by distilling iodine with chlorate of potash; and terchloride of iodine, a compound formed by the prolonged action of chlorine upon iodine. It occurs in crystalline orange needles, soluble, with partial decomposition, in water. With bromine it forms two unimportant compounds,—the protobromide and pentabromide. The compounds in which iodine is united to a base will be found described under the heads of the bases. In examining the properties of iodine, bromine, and chlorine, it is impossible not to be struck with the close analogy between these bodies. They form one of those remarkable triads which we find existing amongst the elements, of which sulphur, selenium, and tellurium, lithium, sodium, and potassium, are examples. If we add together the largest and smallest equivalent numbers of any of those triads, and divide it by 2, we obtain a number closely corresponding to the equivalent of the third member of the group. Thus,—

Equivalent of chlorine .... 35·5
Equivalent of iodine .... 127·0

2) 162·5 = 81·25

80 being the equivalent of bromine; or, in other words, the equivalent of bromine is exactly half-way between the other two. Now, we find bromine to occupy an exactly intermediate position between chlorine and iodine in all its properties. From these facts, M. Dumas has ventured to draw the conclusion that bromine is made up of half an equivalent of iodine and chlorine. It is, of course, vain to speculate upon the truth of this hypothesis in the present state of science; but these, and many other facts, point to the inevitable conclusion that many of the substances which we consider to be elements are, in reality, compounds.—For a more complete discussion of this subject, *see* C. Greville Williams's *Handbook of Chemical Manipulation*, p. 489.

IODITE, *i'-o-dite*, in Min., an exceedingly rare mineral, containing iodide and bromide of silver, found in Mexico and Chili. It occurs in flexible plates of a pe... or yellowish-grey colour. It has also been f... small quantities at Guadalaraga, in Spain.

IODOFORM, *i-od'-o-form*, in Chem., a compound in which three equivalents of iodine occupy the place of the three equivalents of chlorine or chloroform, *i.e.* C_2HI_3, instead of C_2HCl_3. An analogous compound is formed with bromine.

IOLITE, *i'-o-lite* (Gr. *ion*, a violet; *lithos*, stone), in Min., one of the gem family, known also as dichroite, cordierite, and prismatic quartz. It occurs in granitic and primitive rocks, associated with garnet, quartz, and iron and copper pyrites. Its colour varies from violet ... dark blue.

IONIAN PHILOSOPHY, *i-o'-ne-an*, ... the earliest of the philosophic systems of ancient Greece, and was so called because its advocates were principally natives of Ionia. The principal members of this school are Thales, its founder, who is also styled the father of Greek philosophy, Anaximander, Anaximenes, Diogenes of Apollonia, Heraclitus, and Anaxagoras. Philosophy in Greece first concerned itself with speculations regarding the origin of nature and the primary materials of the world. Thales taught that water was the original element, out of which all things proceeded. According to Anaximenes, air was the primary m...rial out of which all things rose; while Heraclitus ...ted the existence of all things to fire. The two last, however, are not to be regarded as materialists, for they regarded these elements as spiritual essences, analogous to the soul of man. To what may be considered as another

branch of this school, belong Anaximander and Anaxagoras. The former of these regarded the world as made up of numberless small particles, of different kinds and shapes, to the different combinations of which all things owed their existence. Out of primary chaos, certain contraries, as earth and heaven, cold and heat, were first evolved. The whole was moved and directed by an eternal substance, which he called the infinite. This system was also adopted by Anaxagoras, who dwelt still more upon the moving principle by which the elements are brought into combinations of order and beauty, and who may be regarded as the first who clearly and broadly laid down the leading distinctions between mind and matter, the former be the moving principle, perfect and simple, the latter inert matter. The Ionian school became extinct before the more highly-developed system of Socrates.

IONIC DIALECT. (*See* GREEK LANGUAGE AND LITERATURE.)

IONIC ORDER. (*See* ARCHITECTURE.)

IONIDIUM, *i-o-nid'-e-um*, in Bot., a gen. of the nat. ord. *Violaceæ*. The root of the species *I. Ipecacuanha* was supposed by Linnæus to be the true ipecacuanha. It is now known as the *woody* or *false ipecacuanha* of Brazil, and is employed as an emetic in that region. It contains the principle *emetina*. Other species, as *I. parviflorum*, *I. itubu*, &c., have similar properties; the roots of the former constitute the *Cuchunchully de Cuenca*, which is much used in Venezuela as a remedy for elephantiasis.

IPECACUANHA, *ip'-e-kak-u-an'-na*, a name adopted from the language of the South Americans, has been applied to a variety of emetic roots, but is restricted in the Pharmacopœias to the roots of a species of *Cephaëlis* (which *see*). The official root is sometimes called *annulated ipecacuanha*. The root known as *undulated*, *white*, or *amylaceous ipecacuanha*, is the produce of a species of *Richardsonia*; that known as *black*, or *striated*, is obtained from a species of *Psychotria*; and that called *woody* or *false ipecacuanha*, from a species of *Ionidum*. (*See* the above-named genera.)

IPOMŒA, *ip-o-me'-a* (Gr. *ips*, a worm which infests the vine; *omoios*, like, from its habit of twining round other plants, like the creeping of a worm), in Bot., a gen. of the nat. ord. *Convolvulaceæ*. The roots of the species *I. orizabensis* are sometimes found intermixed with those of *Exogonium purga*, the true jalap of the Pharmacopœias. This spurious jalap is known in Mexico as *male jalap*, and in English commerce as *light jalap*. It has similar properties to those of the well-known drug, but is less powerful. The roots of *I. Turpethum*, or the Turpeth, were formerly much used as a purgative. The large roots of *I. macrorrhiza* contain much farinaceous matter, and are used as food by the inhabitants of Georgia and Carolina.

IRIDACEÆ, *i-rid-ai'-se-e*, in Bot., the Iris or Cornflag fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*, consisting of herbaceous plants, usually with bulbs, corms, or rhizomes; parallel-veined leaves, and spathaceous flowers. The perianth is superior, petaloid, and 6-parted, in 2 whorls. The stamens are 3 in number, and are inserted upon the outer segments of the perianth; their anthers are 2-celled, and extrorse. The ovary is inferior, 3-celled, with a single style, having 3 stigmas, often petaloid. The fruit is capsular, 3-celled, and 3-valved, with loculicidal dehiscence. The seeds are numerous, with horny or hard albumen. The plants of this order are chiefly natives of temperate and warm climates; they are particularly abundant at the Cape of Good Hope. There are 57 genera and 557 species. The rhizomes of several species have acrid properties, which render them purgative or emetic; those of others are fragrant. Colouring matter is obtained from some species. Some of the genera furnish the horticulturist with showy border flowers. (*See* CROCUS, IRIS, GLADIOLUS.)

IRIDIUM, *i-rid'-i-um* (Gr. *iris*, the rainbow, from the variety of colours exhibited by its salts), in Chem., symbol Ir, equivalent 98·56,—a somewhat rare metal, found native and nearly pure, amongst the Uralian platinum ores. It also occurs combined with osmium. Iridium is obtained from either of these sources,—by fusing the chloride of potassium and iridium, by a process too long for description here, and reducing the iridium by means of a current of hydrogen. Iridium is a very hard white brittle metal, only fusible by the strongest heat of Deville's gas furnace. In its pure state it is unacted on by any of the acids or aqua regia. It forms three compounds with oxygen,—IrO, Ir_2O_3, and IrO_2, which readily pass one into the other, causing the solutions of their salts to assume a variety of colours. From these changes of colour the name has been conferred on the metal. It also forms sulphides and chlorides, but its salts have been very imperfectly examined. It has been used occasionally for pointing gold pens instead of rhodium.

IRIS, *i'-ris*, in Bot., the Flower-de-luce, the typical gen. of the nat. ord. *Iridaceæ*. The species are very numerous, and are generally remarkable for their large yellow, white, or blue flowers, and sword-like leaves. They abound in Europe, but are rare in America. The rhizomes of several species are more or less purgative and emetic. Those of *I. florentina*, *pallida*, and *germanica* possess a violet odour, and are used in perfumery for imparting an agreeable odour to the breath, and by the French especially for making issue-peas. These rhizomes, dried and scraped, constitute the *orris-root* of the shops. The roasted seeds of *I. Pseudacorus*, the yellow flag of this country, have been recommended as a substitute for coffee, but they do not appear to have any of the valuable properties of that beverage. The genus is named from Latin *iris*, the rainbow, on account of the variety of colours exhibited by it.

IRIS. (*See* EYE.)

IRISH MOSS. (*See* CHONDRUS.)

IRITIS, *i-ri'-tis*, in Med., is an inflammation of the membrane of the eye. It usually commences with pain in the eye and intolerance of light; afterwards the colour of the iris changes, owing to the secretion of coagulable lymph, which spreads over it in a fine flake. Iritis, if it go on, is likely to end in adhesion of the iris to the neighbouring parts, in which case there is a loss of the power of contracting and dilating, or it may even be completely closed. Sometimes an abscess forms and bursts, discharging its contents into the anterior chamber of the eye, and causing an entire loss of vision. In the treatment of this disease, leeches and cupping, and cold applications to the eye, are to be employed; mercury is also usually administered in large doses.

IRON, *i'-run* (Sax. *iren*), in Chem., symbol Fe (ferrum), equivalent 28, spec. grav. 7·844. This important metal is most extensively diffused over nature, occurring not only in the inorganic kingdom, but entering into the composition of vegetable and animal structures. It occurs in nearly every part of the earth, in the form of ores, a full description of which will be found under IRON, METALLURGY OF. It has also been occasionally found native amongst the ores of platinum. It occurs in the metallic state with nickel, cobalt, and other metals, in meteoric stones, some of which weigh as much as fourteen or fifteen tons. Iron may be obtained chemically from the following process, recommended by Berzelius. Filings of the best bar iron, or pieces of pianoforte wire, are mixed with one-fifth of their weight of pure peroxide of iron, and placed in a crucible, with a quantity of powdered glass free from lead. The whole is then exposed to the highest temperature of a wind furnace or smith's forge. By means of the oxygen contained in the peroxide of iron, all traces of carbon and silicon are oxidized, and the result is a button of pure iron of silver-like lustre. Such iron is very tough, and much softer than ordinary bar iron. Pure iron may also be obtained by heating the pure peroxide in a current of hydrogen. Iron reduced in this manner is used in medicine, under the name of Quevenne's iron. In its pure state, iron presents a dusky-grey colour and a rather feeble lustre, which is greatly improved by polishing. Its physical properties are described under IRON, METALLURGY OF. It is not affected by dry air or oxygen; but if moisture be present, it gradually passes into the state of hydrated sesquioxide, or rust, as it is termed in common parlance. At first, the process is slow, but after a time the spot of oxide forms the negative pole of a voltaic combination, and the oxidation proceeds rapidly. The same thing occurs if any other metal be present; thus, the parts of iron railings which are in contact with the solder used in

joining them together, are rapidly eaten away when exposed to the weather. Iron combines with most of the metals to form alloys, and directly with the iron metallic elements. It decomposes the diluted hydrogen acids with great facility, eliminating hydrogen. Nitric acid attacks it with evolution of binoxide of nitrogen. Under certain circumstances, iron is capable of assuming what is termed the *passive condition*. If a piece of clean iron wire be introduced into nitric acid of about 1·35 specific gravity, it is acted upon with great rapidity; but if the metal be touched beneath the surfaces of the acid with a piece of gold, platinum, or plumbago, the action ceases. If a second wire be made to touch the first, and then dipped into the acid, it is also rendered passive. The second wire may also be used to render a third wire inactive. If, however, any of these wires be exposed to the air for a few seconds, they return to their original condition. The same occurs when iron is plunged into nitric acid of specific gravity 1·45, in which it may be kept for years without losing its brilliancy, and if withdrawn and plunged into acid of 1·35, it has no action on it. If it be wiped, however, before doing so, it is dissolved by the weaker acid. The passive condition of iron is supposed to be due to a change in its metallic condition. Dilute sulphuric acid also dissolves iron with evolution of hydrogen. Iron, in the metallic state, is of great use to the chemist for precipitating certain metals, such as copper, from their solutions in the metallic form. By careful fusion and gradual cooling, iron may be obtained in cubical and octahedral crystals.

IRON, GALVANIZED.—A term first given in France, and since adopted in England, to iron coated with zinc by a patent process. The process invented by Mr. W. H. Crawford, and patented by him in 1837, is thus described in the *Repertory of Patent Inventions*:—"Sheet iron, iron castings, and various other objects in iron, are cleaned and scoured by immersion in a bath of water, acidulated with [illegible] phuric acid, heated in a leaden vessel, or used cold in one of wood, just to remove the oxide. They are then thrown into cold water, and taken out one at a time to be scoured with sand and water with a piece of cork, or more usually with a piece of the husk of the cocoa-nut, the ends of the fibres of which serve as a brush, and the plates are afterwards thrown into cold water. Pure zinc, covered with a thick layer of sal-ammoniac, is then melted in a bath, and the iron, if in sheets, is dipped several sheets at a time in a cradle or grating. The sheets are slowly raised to allow the superfluous zinc to drain off, and are thrown whilst hot into cold water, on removal from which they only require to be wiped dry. Thick pieces are heated before immersion in a reverberatory furnace, to avoid cooling the zinc. Chains are similarly treated, and on removal from the zinc require to be shaken until cold, to prevent the links being soldered together. Nails and small articles are dipped in muriatic acid, and dried in a reverberatory furnace, and then thrown altogether in the zinc, covered with the sal-ammoniac, left for one minute, and then taken out slowly with an iron skimmer: they come out in a mass soldered together, and for their separation are afterwards placed in a crucible and surrounded with charcoal powder, then heated to redness, and shaken about until cold for their separation. Wire is reeled through the zinc, into which it is compelled to dip by a fork or other contrivance. It will be understood that the zinc is melted with a thick coat of sal-ammoniac, to prevent loss by oxidation." The other processes are thus related in Ure's *Dict. of Arts, Manufactures, and* [illegible]:—"Mr. Mallet coated iron with zinc by the [illegible] process. The plates are immersed in a cleansing-bath, of equal parts of sulphuric or muriatic acid and water, used warm; the works are then hammered and scrubbed with emery and sand, to detach the scales and to thoroughly clean them; they are then immersed in a 'preparing-bath,' of equal parts of saturated solutions of muriate of zinc and sal-ammoniac, from which the works are transferred to a fluid metallic bath, consisting of 202 parts of [illegible] ... soon as the cleaned iron works have attained the melting heat of the triple alloy, they are removed, having become thoroughly covered with zinc. At the proper fusing temperature of this alloy, which is about 680° Fah., it will dissolve a plate of wrought iron of an eighth of an inch thick in a few seconds."

IRON, MANUFACTURE OF, may be divided into three divisions:—1. *The preparation of the ore.* 2. *The extraction of the metal.* 3. *The purification of the metal.* The preparation of the ore is effected in a very simple manner, either by pounding and levigating, to separate the clay and silica, and other impurities, or by roasting, to draw off sulphur and carbonic acid, and to render the ore the more easily crushed. The extraction of the metal from the ore was formerly effected by means of charcoal, in what was termed a Catalan

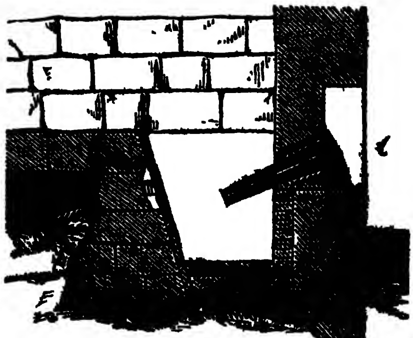


Fig. 1.

forge,—a method much employed in America and Sweden; but it is only used in a few instances in this country. The accompanying figures indicate the construction of these forges. *Fig.* 2 is a vertical section through the axis of the tuyère, and fig. 1 another section at right angles to the former. In fig. 2 W W

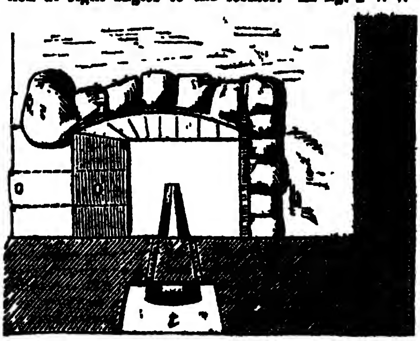


Fig. 2.

represents the wall separating the forge-fire from the blast of the machinery, and in which is the embrasure for the tuyère. The hearth is usually lined with cast-iron plates, and the *counter*, or side opposite the tuyère, of flat bars. Sometimes the lining of these is only a refractory sandstone; but the cinder-slope on the side *o*, fig. 2, of the tuyère, on which the work[illegible] his ringers and bars, is always of cast iron. [illegible] ture *o* is for the discharge of cinder into the [illegible] beneath. The tuyère *t* is a truncated [illegible] copper, with the orifice or eye circular, [illegible] a half to two inches in diameter. The pressure of the blast varies from half a pound to one and a half pound per square inch. Not fewer than three men, exclusive of the hammerman, are required at one of [illegible] In commencing operations, the hearth has first to be

heated by keeping it two-thirds full of ignited charcoal for five hours. The fuel is then thrown against the tuyère, and beaten down upon an inclined plan. towards the counter. Upon this the charge is throw about half at a time, the hearth is heaped up with charcoal, the cinder-tap e stopped with clay, and th. blast gradually let in till, in about two hours, it attains its maximum. During the process the charcoal is frequently put on the top, to prevent it burning too fast. With a crowbar a workman feels at the bottom of the hearth for the cinder and metal, and keeps the tuyère free. From time to time the cinder is tapped and let off. In three hours the whole charge is melted; the metal is then cleared from the charcoal collected at the bottom of the hearth, and then worked into a sort of ball or loop. This loop is next taken to the shingling-hammer to be forged. At first the hammer strikes the loop slowly to condense it, and drive off the cinder. Finally, it is more rapidly forged into the shape of

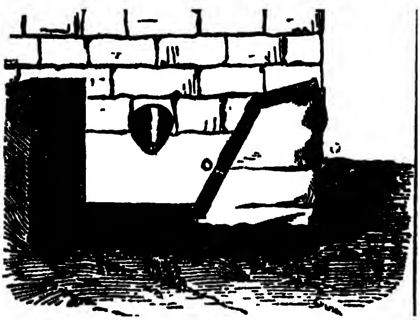


Fig. 3.

a prism. On account of the loss of metal during the process, it will be better to describe the usual method of smelting ores in England by the blast-furnace. A blast-furnace consists of a long cone inverted upon a shorter cone, at the bottom of which is a vertical passage called the crucible, into which are inserted three pipes, termed tuyères, through which the blast is conveyed; also a larger opening, through which the slag may be withdrawn at intervals. At the bottom is a hole called the tap-hole, usually closed with clay, for drawing off the reduced metal when a sufficient quantity is formed. The furnace is fed with coal, limestone, and ore, from a hole near the top, the charge being renewed from time to time, as the materials burn down. The action by which the ore is reduced to the metallic state may be traced as follows:—The oxygen of the air of the blast combines with the carbon of the coal to form carbonic acid during the process of combustion. The carbonic acid, in its passage through the rest of the heated fuel, is decomposed, being converted into carbonic oxide. The carbonic oxide still ascending, meets with the hydrogen and coal-gas, together with which it forms a reducing mixture, abstracting the oxygen of the ore and setting free the iron in a metallic state, which sinks down to the bottom of the furnace, where it comes in contact with the carbon of the coal. With this carbide of iron is formed, increasing the fusibility of the reduced iron to such an extent that the lime, clay, and silica present, which have been converted into a fusible slag, float on the top as an imperfect glass. The slag runs over through the side apertures provided for the purpose, and the metal is withdrawn every twelve or twenty-four hours through the tap-hole. It is run into moulds, consisting of a long channel, from each side of which run shorter ones. The central channel is known as the *sow*, the side ones as the *pigs*; hence the term pig-iron, as applied to rough cast-iron. Great improvements have lately been made in the process of smelting iron, by the introduction of a heated blast for urging the combustion, and by using the combustible gases issuing from the top of the furnace for heating the blast, or the boilers of the steam-engines used for the blowing-machines. These improvements are now in use at most of the principal ironworks throughout the kingdom; and an idea of their importance may be gathered from the fact that, fifteen years ago, a yield of 200 tons per week per furnace was thought to be a large quantity; whereas now, at the Ulverstone and other works, 600 and 650 tons per week is thought an ordinary yield. Not only this, but the amount of fuel used has been reduced to one-quarter by the same means. The iron that comes from the furnace is generally much too impure to be used for any but the very roughest castings; it therefore has to be remelted, to drive off as much as possible of the uncombined carbon, or graphite, silicon, phosphorus, sulphur, and other impurities. A single refusion converts it into what is termed "No. 2 pig," or

ble and liquid metal; a second and

purifying it from carbon, until it is converted into refined or white iron, in which the whole of the carbon is combined with the metal. This description of cast-iron is only used for conversion into malleable iron; for, although it melts easily, it forms a much more pasty mass than some of the intermediate qualities of grey iron, which melt into a more liquid metal, fitting them for casting purposes. Refined iron made from the German spathose ores contains a large quantity of combined carbon and manganese, and crystallises in large plates. It is termed *spiegel-eisen*, or *mirror iron*, from the brilliancy of its crystalline structure, and is much valued for making steel. Founders are accustomed to divide cast-iron into three or four qualities. No. 1, pig or black cast-iron, which contains a large proportion of uncombined carbon. No. 2, or grey cast-iron, which contains more combined carbon. No. 3, or mottled, which contains only a few grains of uncombined carbon here and there, giving it a mottled appearance. No. 4, or refined iron, in which the whole of the carbon is combined. No. 4 is very hard and brittle, and is fit for puddling or conversion into malleable or wrought iron. This is effected by bringing an ingot of refined iron to a state of fusion in a reverberatory furnace, taking care to avoid the contact of fuel. The heat is continued until the ingot parts with its carbon, which is assisted by throwing on it scales of oxide, if produced in the forge. As the carbon burns off, the ingot becomes more and more pasty, until at length it is converted into a granular sandy mass. The heat is now raised until it becomes very intense, and the air is excluded by closing the damper and doors. The metal begins to agglomerate into round masses, or blooms, which the puddler collects on the end of an iron rod, and subjects, while still hot, either to the action of a hammer or to a powerful press, called a sloughing-press, which squeezes out the slag and other impurities, and forces the particles of the iron closer together. The iron is then rolled into bars, and forms what is termed homogeneous iron, a quality of metal much used where great hardness is required. It is distinguished by its granular texture when notched and broken. It is much used for the tops of railway bars and for the wearing surfaces of railway wheels. Where the fibrous quality of iron is required, it is cut into lengths, after the first process of rolling; then piled longitudinally, heated in a reverberatory furnace, and hammered out. This process is repeated several times. Fibrous iron has a fracture like a piece of cane, and is used where resistance to a pulling strain is required, such as in the case of chains, anchors, &c. Railway bars are mostly made with the interior of the rail of fibrous iron, to bear the weight of the passing trains, while the exteriors are made of granular iron, to bear the wearing action of the wheels. The malleable iron of commerce is nearly pure, and may be taken as the type of iron used for metallurgical purposes. Wrought-iron is of a bluish-white colour; it is hard and lustrous when polished, and when rubbed forcibly, it emits a peculiar odour. Its average specific gravity is 7·7 to 7·9, and it requires the most intense heat of a wind-furnace to melt it. It passes into a pasty condition before melting, a property which enables it to be joined together, or welded by hammering. At a red heat, it is possessed of considerable malleability, especially when free from sulphur or phosphorus; but when cold, it possesses but little of this property, as compared with gold and silver. In

ductility and tenacity, it exceeds all other metals, a piece of iron 1½ inch square having been known to bear a strain of 84 tons. It is inferior to many metals as a conductor of heat and electricity. One of its peculiarities is its capability of being attracted by the loadstone or electro-magnet, and of being converted by them into a permanent magnet, when combined with carbon, as in steel, or with sulphur and oxygen, as in magnetic oxide and certain varieties of pyrites. Thus, magnetic oxide, Fe_3O_4, and the two varieties of pyrites, Fe_3S_4 and Fe_7S_8, are all capable of being magnetised permanently; but if the oxygen or sulphur is present in other proportions, they are completely indifferent to magnetic action. Heated to redness, iron loses its magnetic property, but regains it on cooling. Its uses are too well known to need description. The purest variety of commercial iron is piano-forte wire, which may be used as a source of this metal in all chemical experiments. It is converted into steel by being combined with a certain amount of carbon, a process fully explained under the head of STEEL.

IRON, METALLURGY OF.—It will be best to commence the account of the manufacture of this important metal by a description of the typical ores from which it is obtained. The principal ores of iron may, for convenience, be divided into two great classes;—1. the OXIDES; and, 2. the CARBONATES. It will be unnecessary to take into consideration the meteoric masses of iron found in different parts of the world, as their economic use only obtains among savage nations, or as a mere matter of curiosity. The oxides used as ores are somewhat numerous; but may be divided into four distinct classes:—1. *Magnetic iron ore*, or *loadstone*. This ore consists of the protoxide and sesquioxide of iron, mixed with small quantities of silica. It generally contains 69 per cent. of peroxide and 31 of protoxide,—the impurities being so small as not to be counted. It occurs in massive beds in different parts of the earth, more especially at Arendahl and Dannemora, in Sweden. It is also found abundantly in different parts of America. The iron made from it is of great purity, being perfectly free from sulphur or phosphorus; hence the Swedish iron, which is made from it almost entirely, is more valuable than any other. A large deposit of this ore has lately been found in Yorkshire. The titaniferous iron sand found at Taranaki, in New Zealand, consists almost entirely of magnetic iron ore and titanium. Titanium appears to exercise a most beneficial influence on steel containing small portions of it; the Taranaki sand is therefore much valued on this account.—2. *Specular iron, oligist*, or *iron glance*. This ore, which is found principally in the island of Elba, occurs in rhombohedral crystals, which possess great lustre. It is composed of sesquioxide of iron, with a small admixture of magnetic oxide. *Micaceous iron ore* has nearly the same composition, the crystals being in brilliant plates instead of in rhombohedral masses. It is found in small quantities amongst the hæmatites of Wales and Lancashire.—3. *Red hæmatite*. This important ore is found in uniform radiated fibrous masses, in different parts of the world, and consists of the sesquioxide of iron nearly in a state of purity. It is found in large quantities in Wales and Lancashire, some of the specimens from the latter locality containing nearly 90 per cent. of sesquioxide, the remainder being silica. It makes excellent iron.—4. *Brown hæmatite*. This ore consists of sesquioxide of iron in a state of hydration, and occurs in reddish-brown masses of a botryoidal, stalactitic, or reniform shape. Hydrated sesquioxide of iron is also found in amorphous masses mixed with clay. Bog-iron ore belongs to this class. It is a valuable ore, and is found in England, Wales, and Scotland. The CARBONATES are principally two:—1. The *spathose ore*, or sparry protocarbonate, which is found principally in crystalline masses in and about Siegen, in Prussia. It occurs also at Weardale, in Yorkshire, and in one or two other localities in England and Wales. It is valued exceedingly, from producing iron crystallising in large plates, and known in commerce as *spiegel-eisen*. This iron contains certain proportions of manganese and carbon, which render it extremely valuable for steel-making. 2. The *clay*, or *black band ironstone* of the coal-measures, which consists of protocarbonate of iron associated with clay and carbonaceous matter. It is the principal ore of the Staffordshire and Scotch iron districts, where it occurs associated with the flux and fuel necessary for smelting it. The position England occupies with respect to the production of iron may be said to result from this extraordinary association of the three necessary materials for the manufacture of this metal. Iron pyrites cannot be said to be an ore of iron in the strict sense of the word, being only available as a source of sulphur and sulphate of iron.

IRON, OXIDES OF, in Chem.—Iron yields, at least, four compounds with oxygen,—1. the *protoxide*, FeO; 2. the *sesquioxide*, or *peroxide*, as it is often called, Fe_2O_3; 3. the *black* or *magnetic oxide*, which is looked on by some chemists as Fe_3O_4, and by others as a compound of the protoxide and peroxide, $FeO + Fe_2O_3$; and 4. *ferric acid*, a weak metallic acid, only known in combination with the alkalies, $^3FeO_3$. The protoxide, FeO, has never been obtained in a pure state, and does not appear capable of existing in the anhydrous condition. It is precipitated as a white hydrate when a solution of potash is added to a solution of protosulphate of iron; the precipitate, however, rapidly absorbs oxygen from the air, passing first into the green hydrated magnetic oxide, and afterwards into the red hydrated sesquioxide. It forms well-marked salts with the acids. The *protonitrate of iron* is best prepared by decomposing the protosulphate with nitrate of baryta or lead. It forms a light-green solution, from which it crystallizes with difficulty *in vacuo*. If heat be applied, it deposits a basic salt of the peroxide. Its solution is much used in photography as a developing agent, from the greediness with which it absorbs oxygen. (*See* PHOTOGRAPHY.) The *protosulphate of iron*, which is also known by the names of *sulphate of iron*, *green copperas*, and *green vitriol*, is formed when iron or its sulphide is dissolved in dilute sulphuric acid. It is generally prepared from the sulphide, or iron pyrites, by first abstracting a portion of the sulphur by roasting, and then oxidizing the mass by exposure to the air and moisture: by this means oxygen is absorbed, which converts the remaining sulphur into sulphuric acid, and the iron into protoxide. The mass is exhausted with water, and the solution evaporated and crystallized. For chemical purposes, it may be obtained by dissolving 1 part of pure iron in 1½ parts of sulphuric acid diluted with 4 parts of water. It crystallizes in bluish-green rhomboidal crystals, containing 7 atoms of water. The sulphate of iron obtained in commerce has a grass-green colour, owing to a portion of pernitrate being present. Its solution has a strong affinity for oxygen, and is greatly used in photography as a developing agent, having been introduced into that art by Robert Hunt. It is largely used in dyeing and in ink-making; it also forms an important ingredient in medicines which are exhibited in cases of deficiency of iron in the blood. With the sulphates of the alkalies and manganese it forms double sulphates, which must not be confounded with the double salts of the sesquisulphate, which are alums. At a strong heat it is decomposed into *colcothar*, or sesquioxide of iron, much used in polishing metals. The *protocarbonate of iron* occurs in nature as spathose ore and clay ironstone. The other proto-salts are unimportant. *Sesquioxide, peroxide*, or *red oxide* of iron, is obtained in a variety of ways, the best of which is by precipitating a solution of the sesquichloride by ammonia. It falls as a flocculent hydrate, soluble in acid, which may be converted by a moderate heat into the anhydrous sesquioxide, which is attacked by acids with difficulty. It occurs abundantly in nature, and forms most valuable ores of iron. It is much used in colouring glass. It is also extensively employed for the purpose of purifying coal-gas from sulphuretted hydrogen, with which it forms a protosulphide, which, when it ceases to absorb any more sulphuretted hydrogen, is reconverted into the sesquioxide for future use, by exposure to a current of air. It has also been applied to the purification of water. Sesquioxide of iron, under certain circumstances, appears to exhibit feebly acid properties; Pelouse having succeeded in forming a white compound of the composition $4CaO, Fe_2O_3$. The magnetic oxide is regarded by many as a compound of the protoxide and sesquioxide. Heated to whiteness, it forms the magnetic oxide. The sesquinitrate is formed by heating

metallic iron in nitric acid. It is an unimportant salt, crystallizing in yellow four-sided, rectangular prisms. The sesquisulphate is obtained by heating a solution containing one equivalent of the protosulphate with half an equivalent of sulphuric acid, and adding to the solution nitric acid in small quantities, as long as red fumes are given off. A yellowish-white deliquescent mass is obtained. Sesquisulphate of iron, like the sesquisulphates of alumina and chromium, unites with the alkaline sulphates to form alums. The other sesquisalts of iron are unimportant. The *magnetic oxide*, *black oxide*, *ferroso-ferric oxide*, or *protosesquioxide*, as it is variously termed, occurs in nature as loadstone, and forms several very important ores of iron. It may be made by exposing fine iron wire to the action of steam at a red heat, or in a hydrated condition, by peroxidising two parts of protosulphate of iron with nitric acid, to which is afterwards added one part of protosulphate. The whole is then poured into a solution of ammonia, with constant stirring. The hydrated oxide is of a green colour, and is attracted by a magnet. The black oxide produced by heat contains a large proportion of magnetic oxide. *Ferric acid* has not been yet obtained in a separate state. The potash salt may be formed in solution by heating a mixture of one part of sesquioxide with four of nitre to full redness. A brown mass is obtained, which, when washed, gives a violet solution of ferrate of potash. It has never been crystallized, being extremely unstable. It may be obtained in the form of a brownish-black precipitate, by passing chlorine through a strong solution of potash in which peroxide of iron is suspended. Ferrates of soda, lime, baryta, strontia, &c., have also been formed. With chlorine, iron forms two chlorides,—the *protochloride*, which is made by passing dry hydrochloric acid over ignited metallic iron, when it sublimes in yellowish crystals. By dissolving pure iron in a slight excess of hydrochloric acid, it may be obtained in pale-green rhomboidal crystals, containing four equivalents of water. The sesquichloride is obtained by dissolving the sesquioxide in hydrochloric acid, from the solution of which it may be obtained in yellow scaly crystals, with five equivalents of water, or by passing chlorine over heated iron filings, which produces the anhydrous salt in brown scales. The impure solution has been greatly used as a sewage deodorizer. Iron forms two bromides, which are unimportant. Iodine combines with it in two proportions,—FeI, the protoxide, made by dissolving iron wire or filings in water containing four times their weight of iodine, forming a solution which yields pale green crystals on evaporation; and the sesquiiodide, Fe_2I_3, formed by dissolving sesquioxide of iron in hydriodic acid. It is a red volatile deliquescent mass. The protiodide is used in medicine in combination with syrup, which retards its decomposition. Iron forms numerous compounds with sulphur, the only important ones being the *protosulphide*, FeS, and the bisulphide, FeS_2, or iron pyrites. The protosulphide is occasionally found in nature, but it is generally made by projecting into a red-hot crucible a mixture of thirty-two parts of iron filings and twenty-one parts of flowers of sulphur. It is largely used in the laboratory as a source of sulphuretted hydrogen. The *bisulphide* occurs abundantly in nature as iron pyrites, and is used exclusively as a source of sulphur and green copperas. The compounds of iron with phosphorus are unimportant, except as exercising a deleterious influence on metallic iron containing them. With carbon it forms one carbide, FeC_2; however, very small quantities of carbon exercise an important action in the formation of steel. (*See* STEEL and CAST-IRON.) Boride of iron has been obtained by reducing the borate by hydrogen, and silicide of iron is supposed to enter into the composition of *wootz*, or Indian steel. A nitride of iron has been obtained by Fremy, as a white powder of uncertain composition. The compounds of iron salts, with the salts of the organic acids and bases, are numerous and important, being much employed in medicine. The citrate of quinine and iron, of ammonia and iron, and many others, form elegant preparations much in vogue. They are mostly uncrystallizable, and are generally prepared in the form of scales, by evaporating their solutions on glass, and stripping off the horny transparent masses formed.

IRONY, *i'-ron-e* (Gr. *eironeia*), in Rhet., is a form of expression in which the words used convey a meaning the direct contrary of what is intended. The essence of irony consists in its being simple and natural, not too closely concealed, so that its meaning may be hid, and yet not so patent as to deprive it of its natural character. In speech, there is usually a particular tone in which irony is expressed. The meaning given to this word by the ancients was somewhat different from that in which it is now employed: it denoted an ignorance purposely affected, to provoke or confound an antagonist, and was much employed by Socrates against the Sophists, who indeed obtained the name of the Ironical.

IRRADIATION, *ir-răd-ĭ-ai'-shun* (from Lat. *irradio*, I shine), a term generally used to signify the apparent enlargement of the disc of a celestial body. In a more restricted sense, the word properly denotes the emission of rays from any luminous object. Irradiation, as an enlargement, is caused either by a deviation of the rays of light from a rectilinear direction, or by some illusion caused by the action of light on the eye. When rays of light from points on the surface of an object fall on the retina, an agitation may be produced, extending to within short distances near the points to which the humours of the eye cause the rays to converge. A perception may consequently arise, of a fringe or border round a luminous body, which will give an apparent enlargement of such body. A star, for instance, seen with the naked eye, seems to be a disc of sensible magnitude. On account of its distance it would appear to be a point, if the rays of each pencil of light produced no effect beyond the axis of convergence. Thus, the discs of both the sun and moon are in like manner conceived to be apparently enlarged. When the moon is new, the part which is rendered luminous by the sun appears to be a portion of a larger sphere than the part which is more faintly illuminated by the reflected light from the earth: this phenomenon is also accounted for by the apparent enlargement, by irradiation, of the part enlightened by the sun. A kind of irradiation may also be produced, more or less, in a telescope, from defects in the object-glass, the irrationality of dispersion and diffraction, all of which give an apparent magnitude to a luminous point. The apparent magnitudes of celestial bodies were very erroneously estimated before the invention of the telescope. Tycho Brahe estimated the diameter of Venus to be twelve times, and Kepler seven times, greater than it is now known to be. The cause of such mistakes is not removed by the telescope, but, by increasing the seen diameters without magnifying the effect of radiation, a proportional diminution is made in the error caused by the apparent enlargement. Objects which are of equal size, through the effect of irradiation, often appear to differ in size: this effect depends either on their colour or the quantity of light which falls upon them. It was remarked by Sir William Herschel, that when a bright circle was viewed together with a dark one on a bright ground, the former always appeared larger than the other; and in order to correct the error in estimating the magnitudes of the columns about temples, when seen against a bright ground, the ancients made the thickness of the columns to increase proportionately to the distance between them. Vitruvius, in his work on architecture, explains this practice by saying that the columns with wide intervals, being more surrounded by the air, appear on that account to be more slender than those which are closer. The perceptions of magnitude, however, depend partly on those of distance, and a contrary effect frequently takes place with objects viewed against the sky, when they are believed to be more distant than is really the case. (*See* INTERCOLUMNIATION.)

IRRATIONAL, *ir-rash'-o-nal* (Lat. *irrationalis*), a term applied, both in Arithmetic and Algebra, to numbers or quantities whose roots are incommensurable with unity, and which cannot, therefore, be accurately extracted. Thus, the root of 2, or $\sqrt{2}$, is irrational, because it cannot be expressed by any finite number. If the side of a square be equal to 1, then $\sqrt{2}$ will be its diagonal, and will consequently be irrational; for geometry teaches us that the diagonal of a square is incommensurable with its sides. In Algebra, irrationals are termed *surds*; and although they cannot be

any finite numbers, yet close approximations can be made to their intrinsic values. Nothing shows this more plainly than the evolution of binomial surds, which gives as near a value as possible to the result aimed at. The theory is as follows:—Assume $\sqrt{x}+\sqrt{y}=\sqrt{a+\sqrt{b}}$; then, by squaring each side, gain $x+y+2\sqrt{xy}=a+\sqrt{b}$; $\therefore x+y=a$, and $2\sqrt{xy}=\sqrt{b}$. From these two equations we find x and y thus,—

$$\left.\begin{aligned} x^2+2xy+y^2&=a^2 \\ 4xy&=b \end{aligned}\right\} \therefore x^2-2xy+y^2=a^2-b$$

And, $x-y=\sqrt{a^2-b}$; but $x+y=a$

$$\therefore x=\frac{a+\sqrt{a^2-b}}{2}, \text{ and } y=\frac{a-\sqrt{a^2-b}}{2};$$

which gives us the nearest approximation to the value of the root $\sqrt{a+\sqrt{b}}$.

Irreducible Cases, *ir-re-du'-si-bl* (Lat.), are well expressed to be those peculiar cases in the solution of cubic equations in Algebra, where Cardan's theory, or formula, fails in its application, on account of its imaginary expression. This unfortunate circumstance caused great difficulties to arise in the paths of early analysts; and even up to the present day all efforts may be deemed unsuccessful. In Brande's Dictionary, a clever article on the subject well explains the difficulty. "In order to show in what it consists, let the proposed cubic equation be $x^3+ax+c=0$; then, by Cardan's rule, we have $x=\left(\frac{1}{2}c+\sqrt{\frac{1}{27}a^3+\frac{1}{4}c^2}\right)^{\frac{1}{3}}+\left(-\frac{1}{2}c-\sqrt{\frac{1}{27}a^3+\frac{1}{4}c^2}\right)^{\frac{1}{3}}$. Now if, in this expression, a is negative, and $\frac{1}{27}a^3$ is greater than $\frac{1}{4}c^2$, then $\frac{1}{27}a^3+\frac{1}{4}c^2$ will be a negative quantity, and consequently the extraction of its square root will be impossible, as the expression $\sqrt{\frac{1}{27}a^3+\frac{1}{4}c^2}$ will be imaginary. (*See* Imaginary Quantities.) But it is known, from the theory of equations, that every cubic equation must have at least one real root; and it is a circumstance not a little remarkable, that those cubic equations in which this imaginary expression occurs have not only one real root, but have all the three roots real. It is possible to disengage the expression for the value of x from the imaginary quantities by expanding it by the binomial ... in the one series and negative in the other; and therefore, on adding the series together, they will be eliminated." However, the series which results from this source will rarely be what is termed convergent, and, consequently, the method will be deprived of any utility it might have appeared to possess. The following method is, perhaps, the simplest of the many which have been devised wherewith to solve the difficulty of cubic equations. Suppose $x^3-xy=z$ be the proposed equation, an arc, a, must then be found in the trigonometrical tables whose natural cosine is $3z\sqrt{3}+2y\sqrt{y}$; then the three roots of the equation will be—

$$x=2\sqrt{\tfrac{1}{3}y}\times\cos\tfrac{1}{3}a$$

$$x=2\sqrt{\tfrac{1}{3}y}\times\sin\tfrac{1}{3}(90^\circ-a)$$

$$x=-2\sqrt{\tfrac{1}{3}y}\times\cos\tfrac{1}{3}(90^\circ-a).$$

These formulæ will apply whether z be negative or positive; but when z is negative, it would simplify the elimination if the arc a should be chosen, so that its *sine*, and not its *cosine*, be equal to $3z\sqrt{3}+2y\sqrt{y}$, when the roots will be found in a much easier manner.

Irrigation, *ir-re-gai'-shun* (Lat. *irrigo*, I water).—In general language, this term is employed in Agriculture to signify the watering of the earth to increase its fruitfulness. In a more confined sense, the term is applied to that species of flooding which consists in spreading a sheet of water over a field or meadow, in such a manner that it can be readily withdrawn. Water is the most essential of all the substances which concur in the vegetation and growth of plants: no seed can germinate, and no plant receive nourishment, without moisture. No verdure exists in those warm climates where the rains are periodical and the soil is dried up by continual evaporation, unless springs or rivers supply the moisture required; and vegetation is always the most luxu ... in abundance of ...

... of irrigation. ... the earth, chiefly to produce increased crops of grass, has been in use from a very remote period. In many parts of the East the climate is such that, in various situations, soils now fertile would be rendered sterile, were not the ground enriched with copious supplies of water. In patriarchal times, various hydraulic machines were used for the purpose of supplying the ground with water. Some of these resembled the water-wheels of the fen-districts of England, and were worked by the feet of men, somewhat after the manner of the modern treadmill. It is to this custom that Moses alluded when he reminded the Israelites of their sowing their corn in Egypt and watering it with their feet (Deut. xi. 10). In the sandy soils of Arabia, a similar practice still exists. At the present day, in Egypt, water is sometimes raised, for purposes of irrigation, by means of a wicker basket lined with leather, which is held by cords between two men, who, by this laborious means, swing it over the banks of the Nile into the canal which conveys it to the lands intended to be irrigated. The early employment of irrigation by the Egyptians and Chinese was most probably the result of the good effects which were observed to be produced by the overflowing of the Nile and the Chinese rivers. In Italy, especially on the banks of the Po, irrigation has been carried on since before the time of Virgil; and the process is still employed in the same district with great care and zeal. After the fall of the Roman empire, agriculture rapidly declined; but, singularly enough, irrigation continued to be practised throughout the dark ages with great success. This was more especially the case in Lombardy, where the princes patronised and followed the example of the various religious establishments. The waters of the chief rivers of Northern Italy, such as the Po, the Adige, the Tagliamento, and of all the minor streams, are used at the present day in irrigation. No other country possesses so large an extent of rich water-meadows as that portion of Italy. The whole country, indeed, from Venice to Turin, may be said to be formed into one great water-meadow. From Italy the practice spread into France and Spain, and lastly into Britain. In Bengal, wells are dug in the highest parts of the fields, and from them, by means of bullocks and a rope over a pulley, water is raised in buckets, and conveyed to all parts of the fields by small channels. Long before the discovery of the new world by Columbus, irrigation was practised by the Mexicans. They collected the water from mountain torrents, and conducted it to their lands by means of proper channels, with great care and skill. It was not till the end of the 17th century, however, that water-meadows were constructed in Britain upon ... like a scientific system. Of these, those in W... which are amongst the most celebrated in ... were constructed between 1700 and 1705. The ... meadows of Hampshire and Berkshire were made about the same time. Towards the conclusion of the 18th century, great improvements took place in this branch of agriculture. With regard to the precise manner in which irrigation acts, it would seem that much depends upon the chemical properties of the river-water employed. Atmospheric air and water contain all the principal elements of vegetables; namely, oxygen, hydrogen, nitrogen, and carbon; the rest are either present in the soil, or held in solution in the water. Besides, it seems probable that water has an important office with respect to the growth of plants. If the principle discovered by Macaire be admitted, namely, that plants reject through their roots those portions of the sap which form the residue of its elaboration, these portions can be of no further use to the plant, and may, in fact, be injurious to it. It may be, therefore, necessary to remove this residue, or excrement, as it may be called; and the percolation of water through the soil would appear to be the means which nature has provided for this purpose. It ... therefore, be readily supposed that the simple ... of the roots with pure and soft running wa... beneficial effect upon plants. If water be ... grow stagnant, and to evaporate, leaving the ...

matter in solution to remain in the soil, all the advantages of irrigation are lost. In such cases, rushes and coarse aquatic plants grow instead of grasses, as may be seen in all marshy places. Irrigation, to be effectual, depends, therefore, upon the circulation of the water; and the more porous the soil, and especially the sub-soil, the more vigorous is the vegetation. In all cases of irrigation, the water, whether it comes from natural lakes and rivers, or artificial wells and ponds, must first be above the level of the land to be irrigated. This is generally the most important point to be considered. There must also be a ready exit for the water; consequently, the land must not lie lower than the natural receptacle of the water. One of the first and most important steps in irrigation is, therefore, taking the level. This becomes a simple matter when the ground lies along the banks of a running stream. A channel, receiving the water at a higher point than that to which the river flows, may be dug at a less declivity than that of the bed of the stream, and made to carry water higher than the banks of the river; from which level it can be allowed to descend slowly, and irrigate a considerable space, before it returns to the stream. This form of irrigation is the most common; and the size, shape, and direction of the channels depend on the nature of the soil, surface, &c. In all irrigation, the general principle may be described as the supply of an abundance of water to every portion of the surface, and taking it off again with rapidity. Artificial modes of effecting these two results are often necessary. When the surface to be irrigated is flat and level, it is frequently necessary to form artificial slopes for the water to pass over. The whole of the ground is then laid in broad undulating beds, the upper part of which is quite level from end to end when the supply-channel is cut. All the supply-furrows are fed by a main channel at right angles to the beds and somewhat above them. When the flood-gates are opened, the water flows into all the upper channels very regularly, till it fills them to overflowing in their entire length. The best water-meadows are those which have a perfect command of water and a regular supply. During frost, when the vegetation of dry meadows is suspended, the water-meadows are allowed to have a current of water flowing over them. By this means they are protected from the effect of frost, and the grass continues to grow as long as the water flows over it. Whenever the temperature is above freezing, however, the flow of water is stopped, as too much moisture would be injurious to the vegetation. By this means, at the first sign of spring, before the dry meadows have recovered from the effects of winter, the grass grows rapidly in the water-meadows. By careful and judicious management, two or three crops of grass can also be obtained in one season. When the water is suited for irrigation, the land never requires manure. The best soil for a water-meadow is a good gravel. The water of the Avon, in Wiltshire, would appear to contain all the principles essential to rapid vegetation; for the finest and richest water-meadows on its banks are situated in a mere bed of shingle matted together by the roots of the grass. In England, the great advantage of water-meadows is not so much the superior quantity and quality of the grass produced, as the early spring crops furnished by them. They thus afford pasturage to ewes and lambs, which can, by this means, be brought earlier into the market. Christmas is the usual time for letting the water on to water-meadows, and it is generally allowed to flow over while the frost lasts: if the weather is mild, it is shut off during the day and turned on at night. The grass begins to grow rapidly, and is soon ready to be fed off. There is, perhaps, no agricultural question of greater importance, in a national point of view, than the improvement of land by irrigation; for, by its means, all the rich organic and other matters diffused through the rivers, which would otherwise be borne to the sea, are saved to agriculture.

IRVINGITES, *ir'-ving-ites*, is the name commonly given to a sect of Christians, after the Rev. Edward Irving; but who style themselves "the Catholic Apostolic Church." In the winter of 1829-30, Irving delivered a series of discourses in his church in Regent Square, London, on the subject of spiritual gifts, and soon after various persons of his congregation professed to be gifted with unknown tongues, the spirit of prophecy, &c. By these persons Irving was led away, and, being expelled from his own body, became the founder of a new sect,—the Irvingites. They recognize, as the only standards of faith, the three creeds of the catholic church—the Apostles', the Nicene, and St. Athanasius's. They hold that supreme rule in the Church ought to be exercised, as at first, by twelve apostles, not elected or ordained by men, but called and sent forth immediately by God. Besides apostles, they have prophets, evangelists, and pastors, forming the ministry of the Church. These, together with the powers and gifts of the Holy Ghost dispensed and distributed among her members, they regard as necessary for preparing and perfecting the Church for the second advent of the Lord. The congregations are placed under the pastoral rule of angels or bishops, with whom are associated in the work of the ministry priests and deacons. The deacons are a distinct and separate order of ministers, chosen by each congregation out of their own number, and ordained either by apostles or angels. The priests are first called to their office by the word through the prophets, and then ordained by apostles, and by a like call and ordination are the angels chosen from among the priests. The holy eucharist is celebrated every Lord's day, and there is divine worship several times daily. The worship is conducted by means of a ritual which embodies portions of the rituals in use in all different sections of the Church, Greek, Roman, and Protestant. In their ritual observances and offices of worship, external and material objects occupy a large place. Music and painting, vestments of divers colours, incense, lights, &c., are all employed to minister through the senses what is conveyed to the intell[illegible] and the spirit by words. When the numbers and means admit, the worship is conducted with the greatest magnificence, while it is also capable of adaptation to very narrow circumstances. Besides free-will offerings, members contribute a tenth part of their income to the support of the priesthood. The great object of interest with them is the hope of the speedy coming of Christ. In England there are about thirty congregations of them, comprising about 6,000 communicants; and there are also congregations of them in Scotland and Ireland, Germany, Switzerland, France, Canada, and the United States.

ISAIAH, *i-zai'-yă*, is the name of the first, in order, of the prophetic books of the Old Testament, and called after its author. Isaiah prophesied under the reigns of Uzziah, Jotham, Ahaz, and Hezekiah. According to a Jewish tradition, he was sawn asunder, by order of Manasseh; but this is very doubtful. Down to the latter part of the last century, Isaiah was universally regarded, both by Jews and Christians, as the author of this book; but since that time, the German rationalists have been endeavouring to prove that the book is a collection of prophecies made by different persons, and collected and arranged during the Babylonish captivity. For the arguments against this view, see Jahn's "Introduction to the Bible;" Prof. Lee's "Sermons and Dissertations;" Hengstenberg's "Christologie des alten Testaments;" Horne's "Introduction to the Holy Scriptures." The predictions of Isaiah may, according to Horne, be divided into six parts, each containing a number of discourses, delivered by the prophet to the various nations or people whom he was commissioned to address. 1. Contains a general description of the estate and condition of the Jews, in the several periods of their history; the promulgation and success of the gospel, and the coming of Messiah to judgment (i.—v.), delivered during the reign of Uzziah, king of Judah; 2. comprises the predictions delivered in the reigns of Jotham and Ahaz (vi.—xii.); 3. contains various predictions against the Babylonians, Assyrians, Philistines, and other nations, with whom the Jews had any intercourse (xiii.—xxiii.); 4. contains a prophecy of the great calamities that should befall the people of God,—his merciful preservation of a remnant of them, and of their restoration to their country,—of their conversion to the gospel, and the destruction of Antichrist (xxiv.—xxxv.); 5. comprises the historical part of the prophecy of Isaiah (xxxvi.—xxxix.); 6. comprises

a series of prophecies, delivered, in all probability, towards the close of Hezekiah's reign. Isaiah has been denominated the evangelical prophet, on account of the number and variety of his prophecies concerning the Messiah. This prophet, says Lowth, abounds in such transcendant excellencies, that he may be properly said to afford the most perfect model of prophetic poetry. He is at once elegant and sublime, forcible and ornamental; he unites energy with copiousness, and dignity with variety. In his sentiments there is uncommon elevation and majesty; in his imagery the utmost propriety, elegance, dignity, and diversity; in his language uncommon beauty and energy, and, notwithstanding the obscurity of his subjects, a surprising degree of clearness and simplicity. To these we may add, that there is such sweetness in the poetical composition of his sentence, whether it proceed from art or genius, that, if the Hebrew poetry is at present possessed of any remains of its native grace and harmony, we shall chiefly find them in the ... of Isaiah.—*Ref.* Horne's *Introduction to the ... Scriptures.*

ISCHURIA, *is-ku'-re-ä* (Gr. *ischo*, I retain; *ouron*, the urine), in Med., denotes a retention of urine, and is distinguished from dysuria in that, in the latter case, the discharge is attended with much difficulty, whereas in the former there is a total retention. They are both either acute, arising from inflammation, or chronic, from calculus, &c.

ISINGLASS, *i'-zing-glis*, a very pure form of gelatine or animal jelly, prepared from certain parts of the entrails of several fish. The best isinglass is prepared in Russia, from the membranes of the sturgeon, especially from its air-bladder and sounds, which are very large. When removed from the fish, they are washed with cold water, and exposed to the air for a short time, to make them stiffen. The outer skin is then removed, and the remainder cut out, and twisted loosely into rolls, according to the size required. These twisted rolls are called "staples," and are known commercially as long and short staples. The first of these is dried in the air, and is considered the best. Isinglass of the purest kind is used in confectionery, and also largely in refining wine and beer. Isinglass is almost without colour, taste, or smell; is usually in thin pieces, and is soluble in water. It is dissolved readily by most acids, but is not soluble in alcohol. The annual importations of isinglass into this country, from Russia, Brazil, the East Indies, Prussia, Guiana, and other places, amount to about 180,000 lbs. Though commonly derived from *ice* and *glass*, the term is probably a corruption of the German correlative term, *hausenblase.*

ISIS, *i'-sis*, was the name of one of the chief deities of the ancient Egyptians, the wife of Osiris. She was the goddess of the earth and of fecundity, and the cow was sacred to her. Her annual festival lasted for seven days. She was usually represented as a woman with the horns of a cow. Her priests were bound to observe perpetual chastity. Her worship came to be widely spread through Greece, where she was identified with Demeter. In Rome too her worship was common, and here her rites were characterised by the grossest licentiousness, so that they were repeatedly prohibited. Tiberius, with a view of putting a stop to them, caused her images to be thrown into the Tiber; but they were afterwards revived.

ISOCHROMATIC LINES, *i-so-kro-mät'-ik* (Gr. *isos*, equal; *chroma*, colour).—When a pencil of polarized light is transmitted along the axis of a crystal, such as mica or nitre, and then received into the eye, after passing through a plate of tourmaline, coloured rings are perceived. To these coloured rings the term isochromatic lines has been applied. If between two ...s of tourmaline, having their axes at right angles ... another, a plate of nitre be placed, having its faces perpendicular to the axis of the natural prism, ... highly polished; and the system held close to the eye be turned towards the sky, or a sheet of white paper, there will be seen a series of oval rings about each of two points as poles, forming together figures resembling the curves called *lemniscata*. The curves receive their name from the circumstance that throughout each the tint is constant.

ISOCHRONISM, *i-sok'-ro-nism* (Gr. *isos*, equal; *chronos*, time), a remarkable property appertaining to all systems in equilibrium, by which, when slightly disturbed ...less, the oscillations resulting are all performed in the same time, or so nearly in the same time that any retardation or acceleration is imperceptible. When a pendulum, for instance, is allowed to vibrate till it rests, it will be found that no perceptible difference exists between the vibrations of longer or shorter extent, the same number of vibrations being made in the same length of time. Again, in the sound produced by a musical string, the finest ear cannot detect any difference in the pitch of a note made by a smart blow on the piano-forte key and a gentle touch; yet ... small difference in the number of vibrations per s... would be perceptible to the ear. Oscillations or vibrations performed in equal times are termed *isochronous* or *isochronal*; and *isochronal lines* are those along which a heavy body descends with a uniform velocity.

ISOLOGOUS SERIES, *i-sol'-o-gus* (Gr. *isos*, equal), in Chem., carbon compounds, that differ from each other by one or more equivalents of hydrogen, but still bear a close relationship. Thus, the derivatives of ethyl, C_2H_5, are isologous with those of allyl, C_3H_5, both of these radicles commencing a series of acids, ethers, alcohols, aldehyds, &c.

ISOMERIDES, ISOMERISM, *i-som'-e-rids*, *i-som'-e-rism* (Gr. *isos*, equal; *meros*, part), in Chem., isomerides are substances which have the same ultimate composition, but different properties, owing to their elements being grouped together in a different manner. Thus, formiate of ethyl and acetate of methyl have precisely the same ultimate composition, but their elements are disposed in a different manner:—

Formic acid, Oxide of ethyl,
C_2HO_3, C_4H_5O $= C_6H_6O_4$; and
Acetic acid, Oxide of methyl,
$C_4H_3O_3$, C_2H_3O $= C_6H_6O_4$.

(*See also* POLYMERIDES and METAMERIDES.)

ISOMEROUS FLOWER, *i-som'-e-rus* (Gr. *isos*, equal; *meros*, a part), a term applied in Bot. to a flower which has the whole of its parts equal in number.

ISOMETRICAL PERSPECTIVE, *i-so-met'-re-kăl* (Gr. *isos*, equal, and *metrein*, to measure), a method of drawing any building, or range of buildings, in such a manner that the height, length, and breadth may be exhibited in the proportion which they really bear ... when the ... les of perspective; in other words, the perspective plane of the paper must be imagined as making equal angles with the three principal dimensions of the figure and the eye, at an infinite distance. Thus lines in the three principal directions will be drawn on the same scale, and that scale the same for all parts of the line. One decided advantage possessed by geometrical drawings is, that measurements from one scale will serve for all the views of an object, whether these be in plan, elevation, or section. While, however, presenting this desideratum, they are deficient in another: by their aid the relative position of vertical to horizontal lines, or *vice versâ*, cannot be delineated on the same paper or plane. Thus, if one view is in plan, it is confined to plan alone, no lines delineating elevation being admissible in the same drawing; hence the variety of drawings required to give the measurements and positions of an object or design having many points of view. The rules of perspective, which we have just considered, are applicable to the delineation of objects by which two or more sides can be seen. Thus, in the case of a box which is longer than it is broad, but having the bottom of the same dimensions as the top, to give drawings *geometrically constructed*, from which a workman might take measurements, three separate views would be essential,—namely, one of the side, one of the end, these being in elevation, and one of the top, this being in plan; the bottom being of the same dimensions as the top, no plan of this would be requisite. Now, by the rules of perspective, the box might be drawn in such a way that the side, end, and top would all be visible. But as the reader will know, if he has studied the matter given in the section on perspective, the lines converge or recede from one another, in order that the idea of distance may be

given, and as the lines to produce this effect are—in comparatively simple subjects—numerous, the intricacy of the drawings renders it a matter of extreme difficulty to take measurements from the various parts with that ease and facility which ought to be an essential feature in mechanical operations. A method of drawing objects, then, by which two or more views could be shown in one drawing, and *yet all measured from the same scale*, is of considerable importance. By isometrical perspective or projection, this desideratum is attained with great facility. The term projection, in its widest sense, means a plan or delineation of any object, but is also used by some writers and practitioners to distinguish the method of drawing in which the principle is involved of delineating the objects as if viewed at an infinite distance; this resulting in all the parts being drawn without the converging or diminution of parts visible in common perspective, from their being viewed from the same distance. The methods by which objects are *projected* are very numerous, but it is foreign to the scope of our work to enter into a detail of their peculiarities; we shall confine ourselves to the elucidation of the simple rules of isometrical projection, which is the only mode by which the various parts of an object so delineated can be measured from the same scale. Professor Farish, of Cambridge, was the first publicly to elucidate the principles of this method of drawing, and he gave the name isometrical as indicative of its chief feature, from two Greek words signifying *equal measurements*. Isometrical projection gives the representation of the three sides of the cube, all of which are equal, and the boundary-lines of which are also equal. In the examples which we present to the reader will be found sufficient illustration of the ease with which objects can be represented by this mode of drawing, and the applicability of its principles to many of the details of architectural, engineering, or geometrical subjects. After the first principles are mastered, the method of adapting them is so obvious, that in many cases a mere inspection of the diagrams will be sufficient; but, whenever opportunity offers, we shall further elucidate them by explanatory and suggestive remarks. We have deemed it better to give numerous illustrations, rather than enter into long theoretical investigations, preferring to run the risk of being thought over-minute in illustrative details to incurring the charge of obscurity, which, if these were less numerous, might otherwise result. The quickest method of forming a cube is by describing a circle, fig. 1, *i d g h e f*, of any

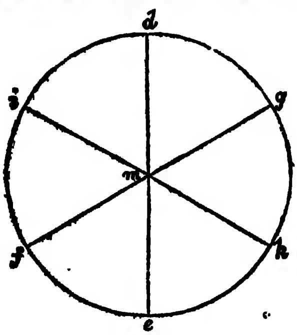


Fig. 1.

diameter, and dividing its circumference into six equal parts, first drawing the diameter *d e* at right angles to the bottom edge of the paper or board on which the circle is drawn; thereafter from either end as *d*, measuring three times to *e*, and thus on both sides; join these points by lines *f g* and *i h*. Now to make the cube, join the lines as in the fig. 2, as *a b*, *b b'*, *b' c*, *c d*, *d e*, *e a*; the cube is complete. The square *a b b' f* is the top, the square *f b' c d* the *right hand*, and the square *d f a e* the *left-hand* side of the cube. In isometrical drawings, all lines which are horizontal in

the geometrical drawing are parallel to any of the lines *d e*, *d c*, *f b'*, *f a*, while those which are vertical are at right angles to these, or parallel to *a e*, *f d*, and *b' c*. Thus, to give the representation of a

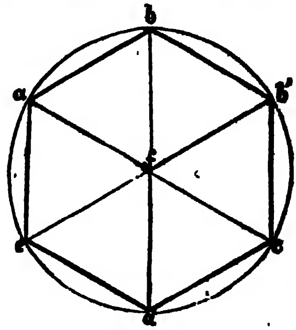


Fig. 2.

block of stone, as in fig. 3, a circle, as in fig. 4, may first be drawn, and a cube formed by the rules given in fig. 2; then to draw the representation of the right-hand face, measure off from *d* to *a*, and parallel to *x* in fig. 3 draw the lines *a b*, *d e*, and from *a* and *b* draw lines parallel to *h e*; *a b e d* is the right-hand side of the block: next put in the left-hand side *a f c d* as before; then from *f* and *b* draw lines *f o*, *b o* parallel to *h h*, *h e*, meeting in *o*; *a f o b* is the upper side of the block. Thus it will be seen that all the lines which are horizontal in the drawings are parallel to the top and bottom lines of the right- and left-hand sides of the cube; while those that are vertical are at right angles to these. In the formation of a cube in a circle, a hexagon is first made by joining the extremities of the

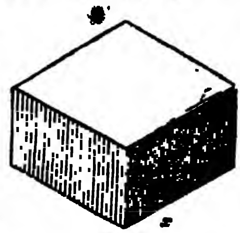


Fig. 3.

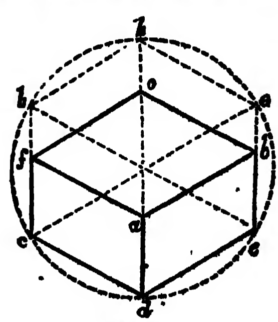


Fig. 4.

diameters, as in fig. 2; *a b b' c d e* is a true hexagon, the cube being ultimately formed by the lines as in the diagram. But simple as this method of forming a cube is, it would be a tedious waste of time to draw each cube required in this way. Make a triangle, the ___ of which will be from two and a half to three inches long, the hypotenuse being at an angle of 30°

to the base, the third side being at an angle of 30° to the base.* Suppose it is desired to make a cube in the circle in fig. 3; draw d b, place the T-square so that its edge lies at right angles to d b, and coinciding with

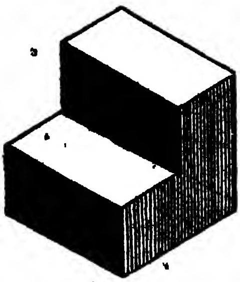


Fig. 5.

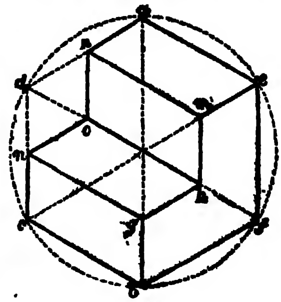


Fig. 6.

the point d; lay the base of the triangle on the edge of the square, and along its hypotenuse draw e b', d e, touching the circle at e; parallel to a f draw a line touching the circle at b'; move the square up towards b'; lay the triangle so that its point shall be towards b', and draw along its hypotenuse the line b' b, meeting

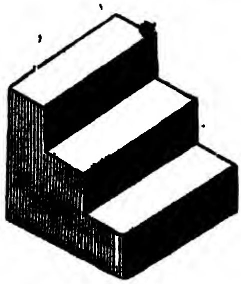


Fig. 7.

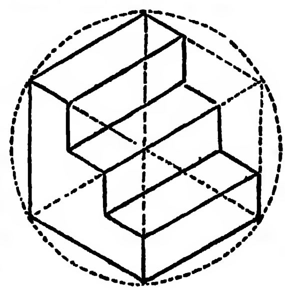


Fig. 8.

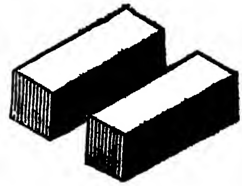


Fig. 9.

d b in b: reverse the triangle, so that its point is towards a; draw a b, and so on, the last line drawn being e d. By this means a circle and its diameter, as b d, being given, a cube can be speedily drawn by means of the triangle. Having thus explained the simplest modes of making isometrical cubes and

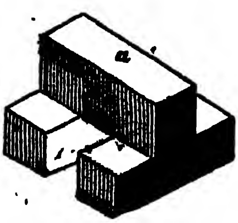


Fig. 10.

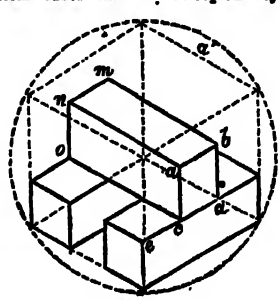


Fig. 11.

systems, we shall proceed to [illegible] these as applicable to the delineation of various objects and forms, first showing how these are contained within circles and cubes without reference to any

particular scale. Believing that the pupil will more speedily obtain a knowledge of the practice of the art by inspection and study of examples than by close attention to theoretical rules, which at the best are dry and [illegible] general reading,—as [illegible] mated, we shall be unsparing in our illustrations, these conveying very rapidly to the mind the nature of the principles. To give the representation as in fig. 5. First draw the circle of any diameter, and put in the cube a d c b f e, fig. 6; put in the lines b f, b a, and measure from b to g. From g draw a line parallel to b e to n, and from e a line to n; next, parallel to f b, draw g h to h; and from h draw h m; draw f e, and from e and m draw lines to and n' parallel to g n or b e; from n n draw lines meeting in the point o, and put in the line h o: the drawing is complete. From an inspection of the figs. 7 and 8, the pupil will be able to draw the representation as given. Fig. 9 gives the isometrical representation of two blocks of stone. In fig. 10 a represents a block laid across two blocks placed in the position as in fig. 9. To copy this, draw the circle and cube as before, and put in the two blocks as in fig. 9; then from e measure to c fig. 11, and from c to d; measure and put in the height of the block c d to a and b; parallel to the side a', draw from a and b to n and m, and from e to n; join a b, n m, and n o: the figure is complete. The two blocks on edge, represented isometrically in fig. 12, will be copied very speedily by proceeding as follows: draw the circle and cube as formerly; and from e measure to b, and from b to e and a (fig. 13),—these give the thickness of the edge of the blocks, as in the copy; next measure from a to e,—this gives the length; and from a e to g and h,—this gives the height of the block. From e and d and b draw the lines b n, e m, and d o, meeting the diagonal c e; from h draw t v a, parallel to e g; and from g, n, m, o, draw to h, v, t, and s; the representation is complete. In fig. 14 is given the representation of an oblong block standing perpendicularly on a flat stone. The method of drawing it is shown in fig. 15. From a draw to d and e,—these give the length of the sides of the under block; from a measure to b,—this gives the thickness; from this point parallel to a e, e d, draw lines meeting perpendiculars from d and e: the right-and

left-hand faces of the under-block are finished. From *a* measure to *e*, and from *e* to *h* and *g*, these lines being parallel to *a c* and *a d*, and giving the breadth of the faces of the oblong block; from *e* measure to *f*, and put in the square *o m f n*; join all the points, and the figure is complete, the distance *e f* being the height of the block. In fig. 16 the same subject is represented, but a succession of under-blocks is given, gradually reduced in size. The method of putting this in will be deduced from a consideration of the mode of drawing the last problem in fig. 15. The representation of the cross given in fig. 17 is an exemplification of the foregoing lessons; the cross being, in a measure, formed of blocks properly disposed. The method of drawing it will be seen by an inspection of fig. 18. In fig. 19 is given a representation of a block of stone *a*, supported by an oblong block, resting on one of the same dimensions as *a*; the pupil should have no difficulty in drawing this, if he has attended to the foregoing lessons. A block of wood or stone with a square part, *a*, cut out of it in its upper face, *b c*, is represented in fig. 20. The pupil should draw it either enlarged or the same size. The representation of a similar block, but with the edges downwards, is given in fig. 21. The manner in which it is drawn is given in fig. 22. The faces *o* and *b*, fig. 21, are formed by the upper and right-hand sides of the cube *m o n s* and *s t v n*, fig. 23, the parts *d e e* being drawn by lines parallel to *m s* and *s g*; the line *d* being the line corresponding to *e f*. The representation given in fig. 23 is a modification of the

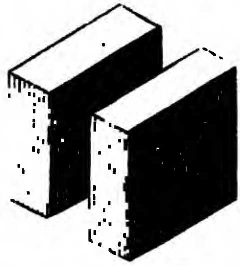


Fig. 12.

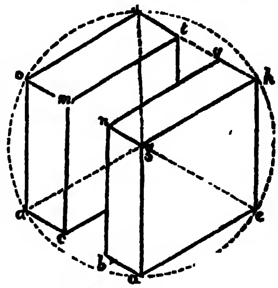


Fig. 13.

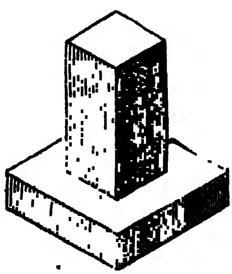


Fig. 14.

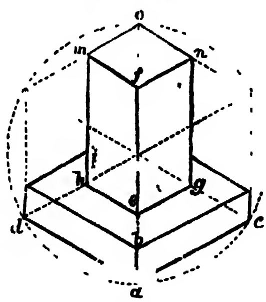


Fig. 15.

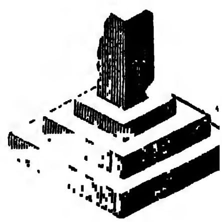


Fig. 16.

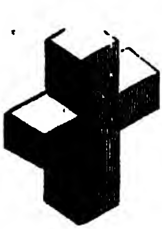


Fig. 17.

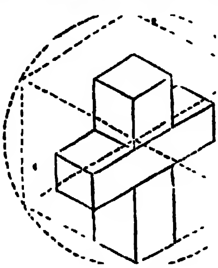


Fig. 18.

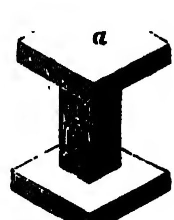


Fig. 19.

previous lesson; it shows the easy method of delineating the representation of apertures in walls, boxes, &c. Thus in fig. 24 a representation of a box is given, *a a* being the thickness of the wood, *e* the size of the interior, and *d* the aperture for the drawer. In the foregoing lessons the examples have been confined to the illustration of objects having only straight lines in their outlines. We shall now show the method of drawing angular surfaces, circles and cubes in all cases being previously described. Thus the representation in fig. 25 is drawn in the manner shown in fig. 26. For the side *a* of the angular block draw the line *a b*, and for *b*, *b c*; measure the height of fig. 23, and set it from *a* to *d*; from *d* draw *d m*, equal and parallel to *b c*; join *d b*, *m c*: the figure is complete. Again, the representation given in fig. 27 is drawn as in fig. 28: draw *e b*, *b d* for the ends of the angular block; from *a*, the centre of the circle, measure to *e* and *f*; from *e* and *f* measure to *h* and *m*; join *fe*, *h m*, *e b*, and *m d*:

the figure is complete. The representation in fig. 30 exemplifies the system of putting in roofs of houses; fig. 30 shows the method in which it may be drawn. First draw the side a, fig. 29, as a d s t, fig. 30; then the side b, by measuring from a to b, and from a, b to

here given will illustrate the a[illegible] with which such objects can be [illegible]; to draw the figure as given by the line of true perspective, would have involved an amount of operations truly puzzling to any one not thoroughly con-

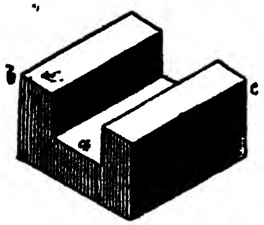


Fig. 20.

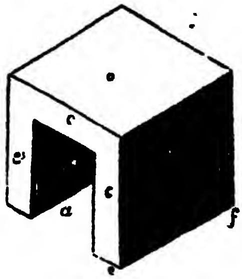


Fig. 21.

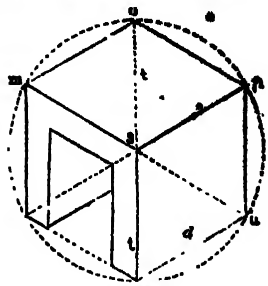


Fig. 22.

e, d; from n, the centre of the circle, measure to n and o, [illegible] draw parallel to d s, the lines n v and o p; [illegible] n, n d, p n, and o s: the figure is complete. [illegible] representation of the plain cabinet given in fig. [illegible] affords an exemplification of the use of the

versant with the principles and practice of the art. But simple as these illustrations seem, and easy as they are to be copied, the operations necessary are much simplified by the use of the isometrical ruler previously fully explained. Thus in all the fore-

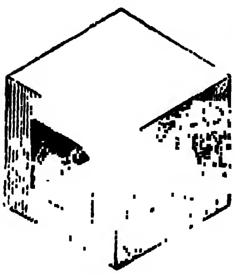


Fig. 23.

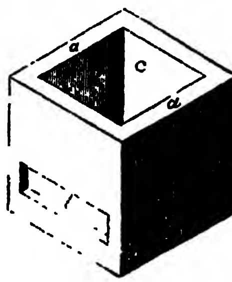


Fig. 24.

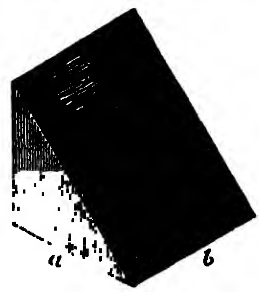


Fig. 25.

isometrical lines of the cube in drawing objects. Fig. 32 explains the mode in which the drawing is executed. The part a d c b should first be drawn, then b g c o b c, next the top, g b h l, measuring from g and h to o and

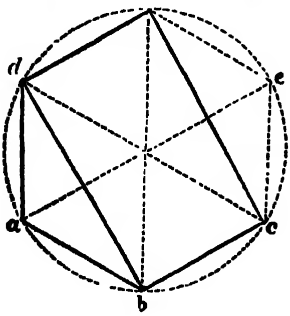


Fig. 26.

m; and joining the parts h m, g o, m o, a m, and c o, the front is put in. After proceeding thus far, the details should next be drawn as in the diagram. The

going lessons, circles and cubes have been drawn, and this was necessary in order to obtain the proper direction of the lines. Now, by the use of the isometrical ruler, the trouble and time expended in drawing an isometrical cube for every object to be represented is entirely obviated. In drawing isometrically, the pupil is recommended in all cases to use the drawing-board and T-square; it will much facilitate his operations. Place the edge of the isometrical "ruler" on the edge of the T-square, so that the lines drawn from f 4, fig. 33, will be at right angles to those drawn from 1 7; let the point of the ruler be towards the left hand, and along the edge draw right-hand isometrical lines 1, 2, 3, and 4, as may be required, and at the distances from each other deemed desirable; reverse the position of the ruler (the T-square remaining unaltered), so that the point shall be towards the right hand; then along the edge draw left-hand isometrical lines 5, 6, 7, &c.; the intersections of these, if all are drawn at the same distances from each other, form isometrical squares, and by joining the points cubes may be formed. Thus, by joining the points g c, a b, and e d, a complete isometrical cube is formed—a e f g being the upper side, a b c g the left hand, and a b d e the right (fig. 33). Simple as this method is, of obtaining the direction of the isometrical lines, when compared with the mode previously given of drawing circles for every example, it may be rendered more so by merely applying the hypotenuse of the ruler in such a way that the right and left hand lines may be drawn at once. Thus, in fig. 34, which represents the combination of timbers

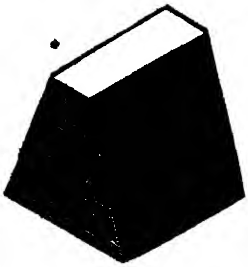


Fig. 27.

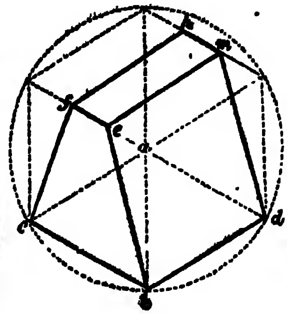


Fig. 28.

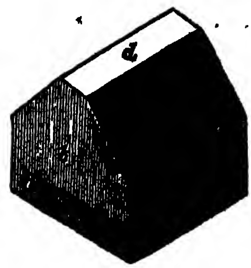


Fig. 29.

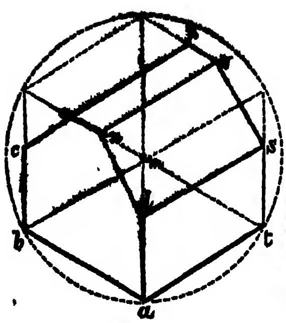


Fig. 30.

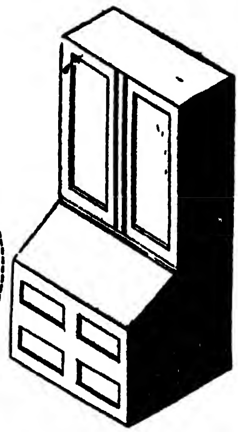


Fig. 31.

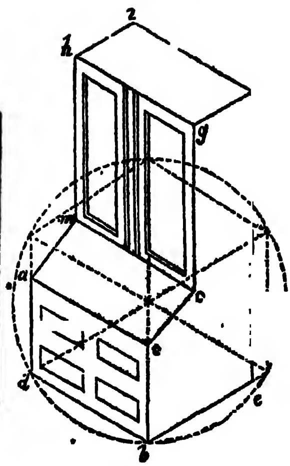


Fig. 32.

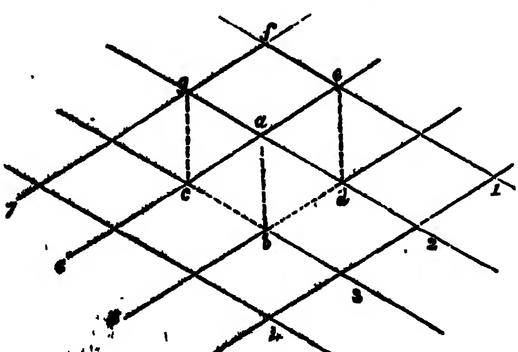


Fig. 33.

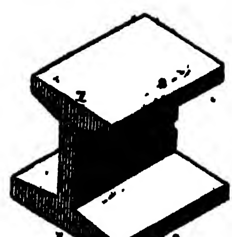


Fig. 37.

Isometrical Perspective

in a "single floor," a a being the rafters and b b the flooring-boards, the lines are at once obtainable by using the ruler, without forming cubes or isometrical

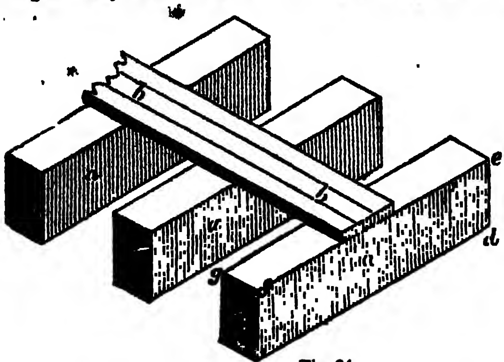


Fig. 34.

squares. Thus, by placing the ruler so that the point may be towards the left hand, the right-hand isometri-

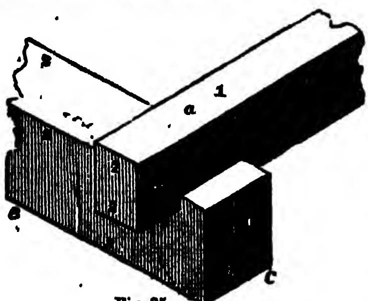


Fig. 35.

cal lines, representing the direction of the lines c d, e f, and all those parallel thereto, are at once drawn,

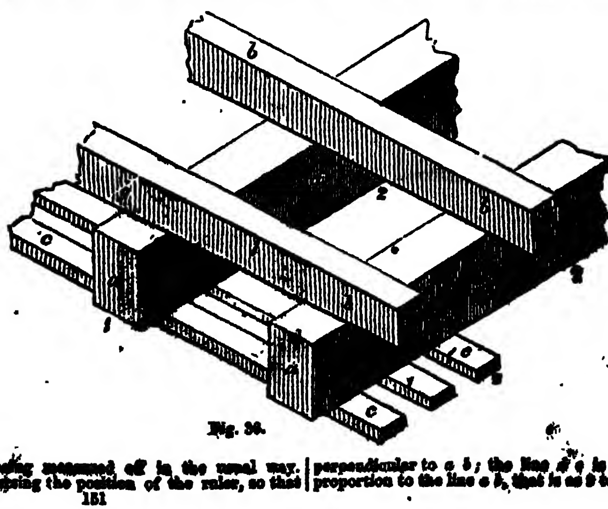


Fig. 36.

the lengths being measured off in the usual way. Again, by reversing the position of the ruler, so that the point shall be towards the right hand, the left-hand isometrical lines, representing the direction of the lines f g of the rafters, or line of direction of the flooring-boards b b, are in the same way easily drawn: the perpendicular lines are put in by the usual methods. In fig. 35 two beams are represented, a being fastened to b by a notch. Here, instead of forming a cube, or isometrical square, the whole of the lines may be put in by the ruler: all the lines marked 1, and th... are right-hand is... are drawn along the edge of the ... when the point is towards the ... hand; the lines 2, and ... thereto, are left-hand iso... and are drawn on the ... being towards the right ... lines, as c a, a e, should be ... from which to take measurements. The representation given in fig. 36 is a combination of timbers called a "double flooring;" a a being the "binding joists," b b the "bridging joists," and c c the "ceiling joists." The lines 1 1, and those parallel thereto, are left-hand isometrical lines, while 2 2 are right-hand ones. In fig. 37 the representation of part of an iron girder is given; and in fig. 38 an elevation of a chimney-stack having three chimney-vents. In both, the lines 1 1 are left-hand, and 2 2 right-hand isometrical lines, and are all put in by means of the ruler. We have hitherto described the construction of isometrical drawings without reference to the use of scales for taking measurements from. If an object be drawn geometrically to a scale, the isometrical projection is not expressible in the same way; thus, the isometrical projection of a square one inch in the side would not measure one inch, but considerably less: the proportion an isometrical line bearing to one of which it is the projection being as 9 to 11. Thus, if the geometrical plan is drawn to a scale of say one inch and three-eighths to a foot, or eleven-eighths, the isometrical projection of the plan will be nine-eighths, or one inch and one-eighth. In fig. 39 a common scale and an isometrical one are given. The way in which the latter is constructed geometrically is as follows: draw the line a b, and divide it into any number of equal parts, as 15; each of these denoting any equal measurement, as eighths of an inch; divide this line again into eleven parts, and with nine of these make the line d e perpendicular to a b; the line d e is in isometrical proportion to the line a b, that is as 9 to 11. The line

Isometrical Perspective

d c is next to be divided into the same number of equal parts as *a b*, as 15. Hence it follows that any measurement taken from the scale of equal parts *a b*

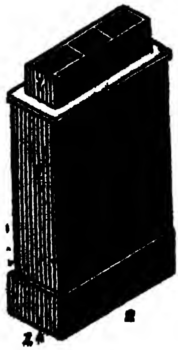


Fig. 38.

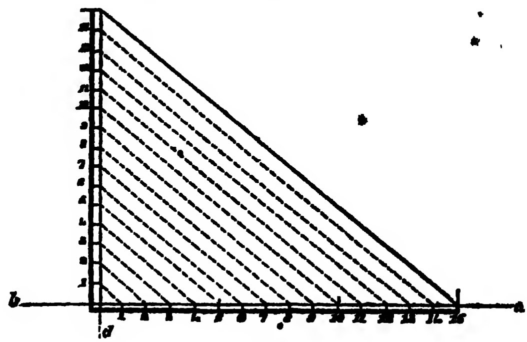


Fig. 39.

can be taken from the isometrical scale *d c*, and all measurements thus taken would be in strict isometrical proportion. Thus in fig. 40, the line *a' m g'* of the

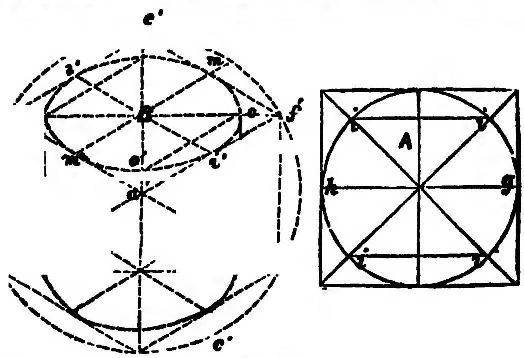


Fig. 40.

square B is the isometrical projection of the line *a g c* of the square A; by measuring these, the line *a' m g'* will be found to be shorter than *a g c*. To put the

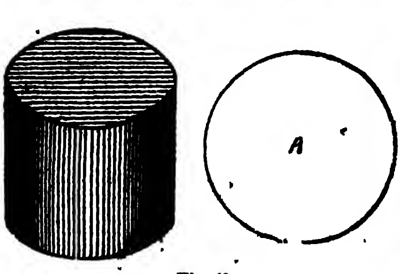


Fig. 41.

circle A in isometrical projection, describe a square *a b d c* about it, and draw the diagonals *a d*, *c b*, and the diameters *e f*, *g h*; at the points *i i i i*, where the circle cuts the diagonals, draw another square, of

Isometrical Perspective

which the lines *i i*, *i i* are two sides. Now as the circle A is to be inscribed in a square which is the face of a cube, drawn in isometrical proportion to *a b c d*, make the radius of the circle *f' c' g' e'* equal to the diameter of the circle A; this being 8, take 8 from the scale *c d*, fig. 39, and from *a'* describe the circle; by the usual method describe the hexagon; and form the cube. The upper face *a' g' e' f* is the isometrical projection of the square *a c d b*. Through the centre of this draw the

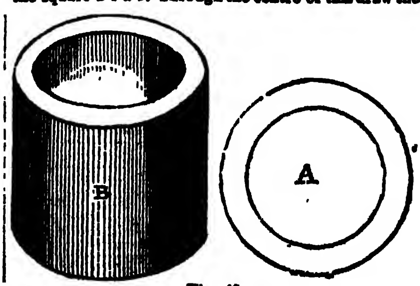


Fig. 42.

diagonals *f' o e g'*, *a' o' e'*,—these are the isometrical projections of the diagonals *a d*, *b c* of the square A; parallel to *a' g'*, *g' e'*, draw the diameters *i' i'*, *m m*,—these are the isometrical projections of the diameters

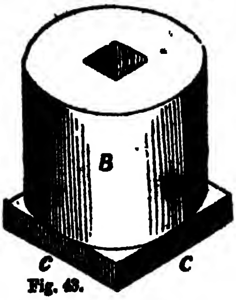


Fig. 43.

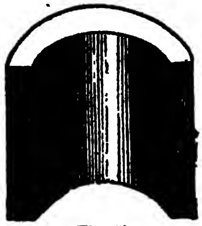


Fig. 44.

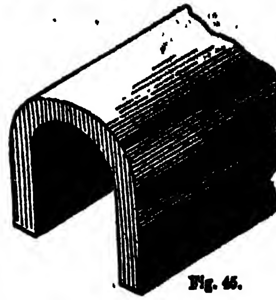


Fig. 45.

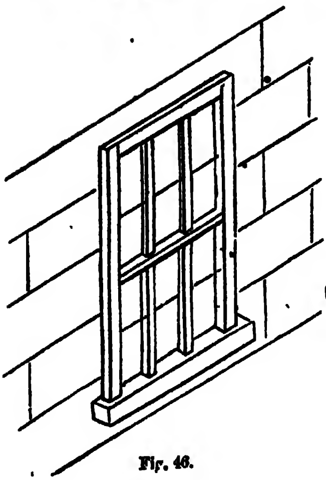


Fig. 46.

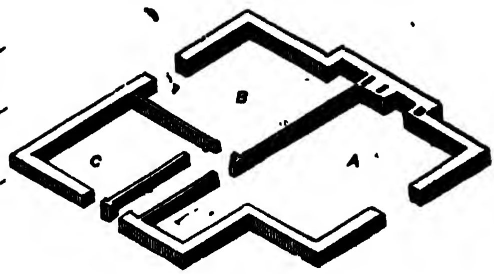


Fig. 47.

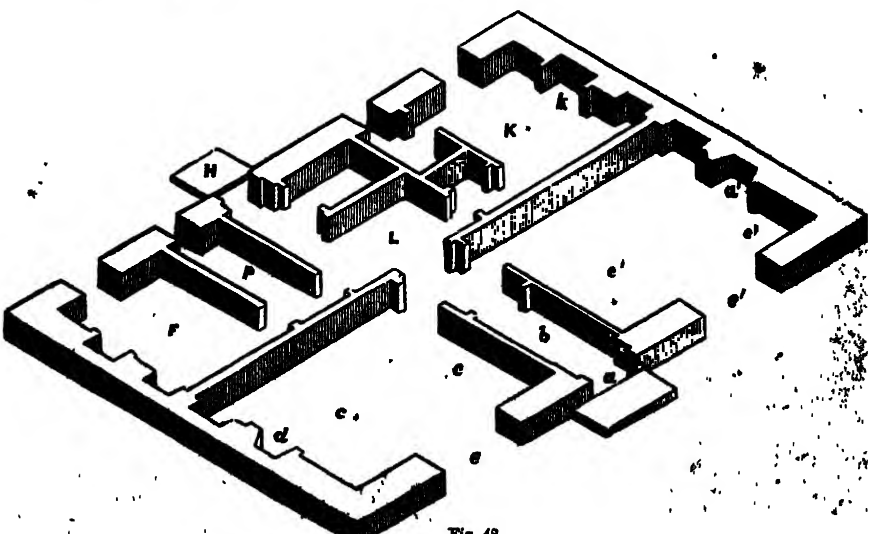


Fig. 48.

e f, *g h* of A. The radius of the circle A, taken from the scale *a b*, is equal to 4 parts; from the centre B of the diagonals of the upper face of the cube, lay off on the diagonal *f' g'* to *c' b*, the distance of 4 parts from the scale *a b*, fig. 39; from these with the ruler, draw the lines *b e d'*, *o i* to *e' g'*, *f' a'*, cutting the diagonal *d' e* in *c' d'*. Now, by the hand, trace through the points *c'*, *i'*, *o*, *m*, *d'*, *i'*, *o*, *m*, as shown by the dotted lines; the curve, which is an ellipse, is the isometrical projection of the circle A. If a cylinder is required as in the diagram, making the ellipse at the bottom part of the cube, as partly shown by the dotted lines. The circles in all isometrical figures are ellipses, the curves of which are found as in the diagram. Where the circles are large, and designed to be traced by the hand, more points may be found in the same way as above described; but where the hand cannot trace the outline sufficiently clear, the ellipse may be geometrically constructed by any of the methods given in works on Plane Geometry, the major and minor axis being found by the above method. In fig. 41 is given the representation of a cylinder, the method of drawing which will be learned from the construction of the preceding figure. In fig. 42 a hollow cylinder (B) is represented, of which A is the geometrical plan; and in fig. 43 a cylinder (B), represented with a square hole (D) running in the direction of its length, and supported on a square plinth *c c*; this figure is an exemplification of the mode in which pillars can be drawn isometrically. The method of using the isometrical scale, for the purpose of giving isometrical proportions to geometrical plans, will be clearly evident from the preceding remarks. If, however, isometrical scales were used in every case, and which would be requisite if isometrical projections were wished to be accurately constructed, the labour of making them would be very considerable, as each geometrical plan would require an isometrical scale to be made for it; that is, if the scale happened in each to be different. This difficulty is easily obviated, and a simple method of drawing isometrically at once available. As we have already noticed, an isometrical line is smaller than a geometrical one, and consequently a series of lines isometrically p... and are, le... which they are ... tions; but suppose two isometrical lines to be enlarged so that they are equal to the geometrical one of which they are the correct isometrical delineations, although they are longer than formerly, they still bear the *same relative proportion to one another*; hence it follows, that if all the lines could be made equal to the geometrical ones, although larger, they would all be in strict proportion to one another, and be capable of being measured from the same scale as used in the plans of which they were an isometrical copy. It also follows that an isometrical copy of any plan might be made in any proportion to the original copy—an one-half, one-third—by reducing or enlarging the original scale, and measuring the isometrical lines therefrom. All that is necessary is, that the lines be drawn in isometrical directions. To draw these with facility,

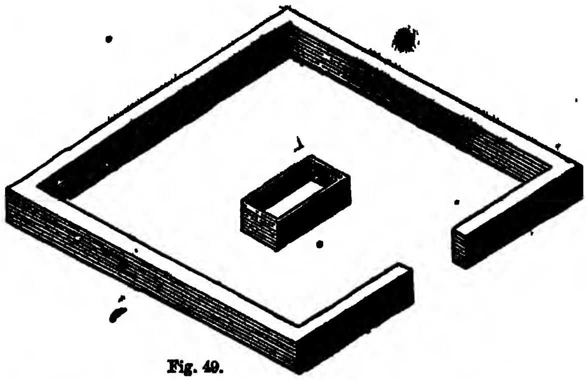


Fig. 49.

we have already given ample instructions. Our remarks on the subject have been confined almost exclusively to the explanation of simple methods of delineating objects in this attractive and useful style of drawing, refraining purposely from entering into theoretical disquisitions regarding either the principles or the practice of "true projection." We trust that

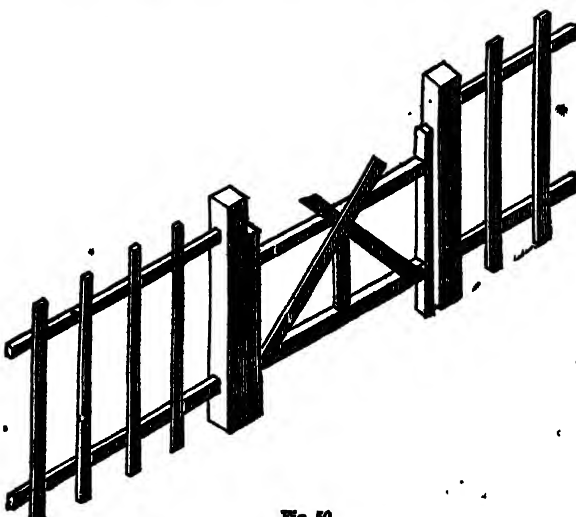


Fig. 50.

we have given instructions which will be easily available. By even a moderate share of attention to the instructions we have given, the reader will be able to understand very speedily the principles of this style of drawing. In all cases we would advise him to persevere in the use of the instruments, and in copying all the illustrations; we can assure him that before he has proceeded far, the labour which at first may be looked

upon as a task, will speedily be deemed a pleasure. We have been unsparing in our illustrations, believing that the pupil will find the principles carried quicker to the mind when the eye is assisted by illustrative delineations. In figs. 44 and 45 are given further exemplifications of the mode of delineating circular objects.

Fig. 51.

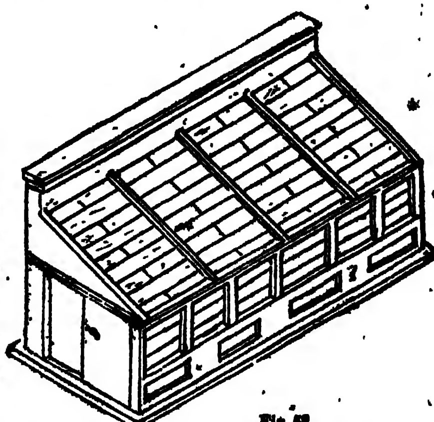


Fig. 52.

Thus fig. 44 is the representation of half a hollow cylinder; this form is applicable to the delineation of parts of machinery, as brasses, sections of pump-barrels, &c. &c.; while fig. 45 shows the method of drawing arches, &c. Isometrical drawing is peculiarly useful in the delineation of architectural subjects, as elevations of houses, plans, and sections, as well as for the parts or details of the various arrangements. In the preliminary lessons we have given several exemplifications of the use of this mode of drawing for the latter purpose, as floors, &c.; we now give in fig. 46 an additional example, being the representation of a window. In fig. 47 we give an isometrical plan of a house with three apartments, A, B, C. The i[sometrical] plan gives the thickness of the walls, parti[tions,] in a clear and distinct style; the height at [which the] walls stand being 12 or 14 inches. But the [whole] height of a wall may be shown by this mode of d[raw]ing, as well as its thickness; thus, in a future [fig.] the reader will find the isometrical drawing of a house with the height of the walls delineated up to the second floor. This, in one view, serves the purpose of a plan and elevation; as the height of the rooms, doors, and windows are plainly delineated, as well as the thickness of walls, position of partitions, fire-

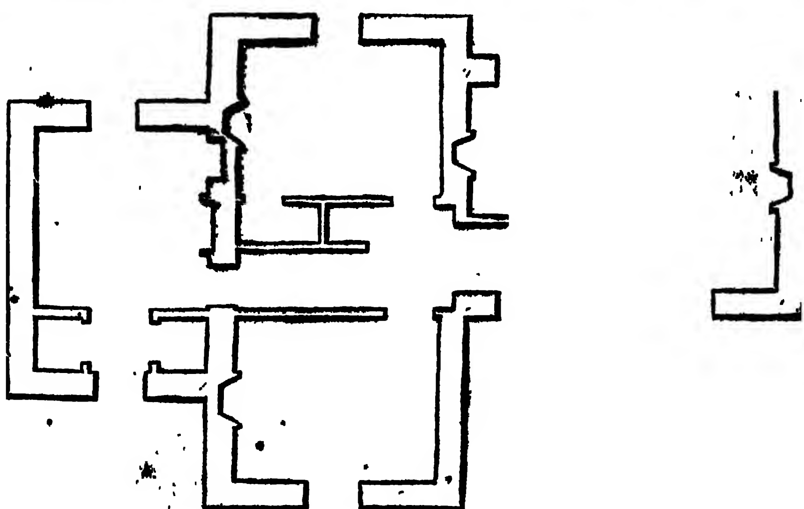


Fig. 53.

places, flues, &c. In fig. 48 we give the drawing of the plan of a house, the height of the walls being somewhere about one-fourth of the actual height. The whole measurements are taken from a scale of equal parts, feet, and inches. Thus *a* is the main entrance-door, with the flag before it; *b*, is the entrance-hall, *c c* the drawing-room, *d* the fireplace, *e* the window;

e' e' is the dining-room, *e'* the fire-place, and *e'* the window. F is a study or small sitting-room, P a closet, H, the back entrance; L, the staircase-lobby; K, the kitchen; *k*, the fireplace. Fig. 49 shows the method of representing agricultural enclosures, or walls of gardens, &c.; a smaller enclosure is delineated in the centre. This diagram exemplifies the way in which the enclosures of a field or fields may be delineated. Where the scale is sufficiently large to admit of the

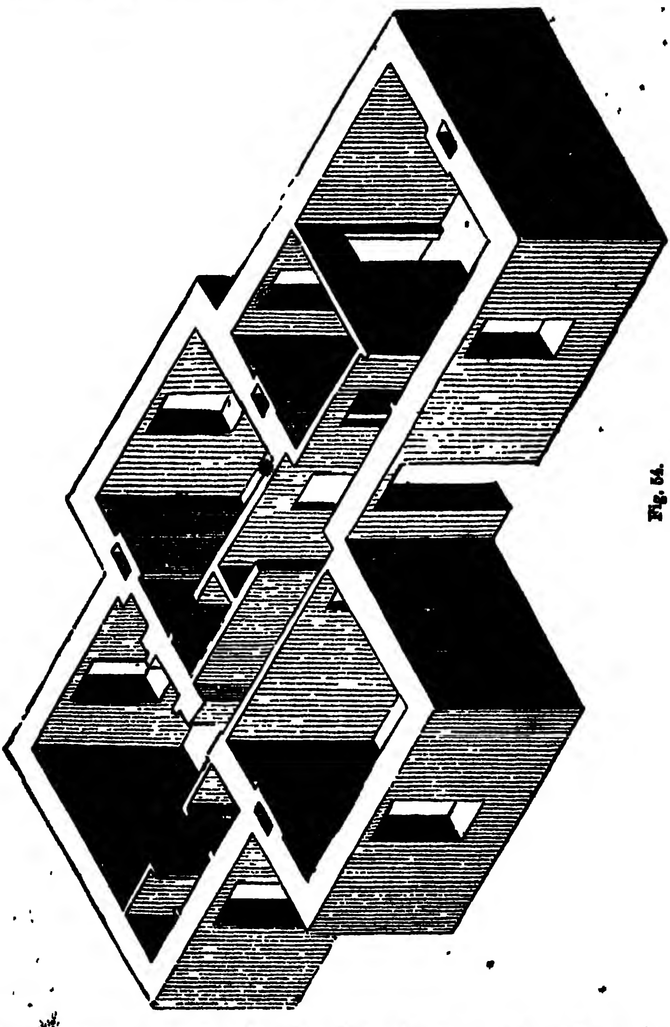


Fig. 54.

details being delineated, the gates and other objects may be [illegible] the plan. In fig. 50 we have given [illegible] of a gate and part of the adjoining [illegible] fence. In fig. 51 the drawing of a [illegible] given isometrically; the length and breadth of [illegible]ouse is shown, as well as the height, position, and [illegible] of windows, chimney-flues, &c. The parts may all be measured from a common scale. The method of applying this style of drawing to the delineation of horticultural edifices is displayed in fig. 52. The length, breadth, and height are all shown in one view; the scantling and position of rafters, glass door, also clearly delineated; drawn to a common scale by means of the isometrical ruler, the measurements of the various parts can easily be taken. In fig. 53 the reader will find the geometrical plan, and in fig. 54 the isometrical drawing of the house previously referred to.

ISOMORPHISM, *i-so-mor'-fizm* (Gr. *isos*, equal; *morphe*, form), in Chem., the property discovered by Mitscherlich, possessed by certain bodies of similar composition, of crystallizing in similar forms. Substances possessing this property are found to be strangely allied in their chemical nature; and the fact of two bodies crystallising in the same form has often led to the discovery of points of great similarity between them. The alums, for instance, no matter what their components, all crystallize in octahedra, and a crystal of potash alumina-alum may be transferred to a solution of ammonia

chromo-alum, which will continue to deposit upon it. The relations subsisting between the following selection of isomorphous groups are well known :—

1.		2.	
Alumina	Al_2O_3	Chloride of Potassium	KCl
Sesquioxide of Iron	Fe_2O_3	Iodide	KI
„ of Chromium	Cr_2O_3	Bromide	KBr
		Fluoride	KFl
3.		**4.**	
Sulphuric acid	SO_3	Magnesia	MgO
Selenic acid	SeO_3	Lime	CaO
Chromic acid	CrO_3	Zinc (oxide of)	ZnO
Manganic acid	MnO_3	Cadmium (oxide of)	CdO

The notation employed to denote certain minerals, containing varying proportions of isomorphous bodies, requires explanation. It often happens that a mineral contains the same collective amount of isomorphous substances united to a certain quantity of oxygen, or any other substance, which may vary in their proportion to each other, within any conceivable limit; in which case the compound is symbolized thus:—(Al Fe)$_2$ O$_3$, which means that the proportions of aluminum and iron are not known, but that, together, they form a quantity equivalent to Al_2 or Fe_2.

ISONANDRA, *i-son-an'-dra*, in Bot., a gen. of the nat. ord. *Sapotaceæ*. From the species *I. Gutta*, and other species, the valuable substance called gutta-percha is obtained. The *I. Gutta*, which is commonly known as the taban-tree, is a native of Singapore, Borneo, and other Malay islands. Dr. Seemann states that it is nearly extinct. (*See* GUTTA-PERCHA.)

ISOSCELES TRIANGLE. (*See* GEOMETRY.)

ISOSTEMONOUS, *i-sos-tem'-o-nus* (Gr. *isos*, equal; *stemon*, a stamen), in Bot., a term applied to a flower in which the stamens are equal in number to the petals, or divisions of the corolla.

ISOTHERMAL LINES. (*See* CLIMATE.)

ISSUE, *is'-sue* (Fr. *issuer*, to go out; Lat. *fonticulus*, a little fountain), in Surg., is an ulcer artificially formed, and kept open, so as to discharge matter, for the purpose of removing an unhealthy condition from some neighbouring part of the system. It is usually formed by making an incision through the integuments with a lancet, or other sharp instrument, sufficiently large for the insertion of one or more peas, which are retained there by a strip of adhesive plaster, so as to prevent the wound from healing, and keep up a state of constant irritation. The actual cautery and caustic potash are also employed in forming issues, being applied to the part till it sloughs, and the ulcer thus formed being kept open, either with peas or some irritating substance. A blister kept open by repeated renewals of the irritating matter, is an issue. Setons are another form of issue, made by passing a broad flat needle, threaded with silk or other suitable substance, under a portion of the skin, and leaving the silk in the passage, with an end hanging out on each side. Issues are principally employed for the removal of chronic disorders of the internal organs, particularly such as are of an inflammatory nature, the object being to withdraw the action from the internal organ, where it might be attended with danger, to without, where it is unimportant. In the management of all issues, great cleanliness should be observed, and the part dressed several times a day.

ISSUE, in Law, has various significations. Sometimes it denotes the children begotten between a man and his wife; sometimes the profits growing from amerciaments and fines; sometimes the profits of lands and tenements; but it generally signifies the point of matter in dispute between a plaintiff and defendant in a cause. When, in the course of pleading, the parties in a cause come to a point, which is affirmed on one side and denied on the other, they are then said to be at issue. [illegible] concerning causes are of two kinds,—upon matter of fact and matter of law. An issue in fact is where the plaintiff and defendant have agreed upon a point to be tried by a jury, an issue in law is determined by the judges. Issues are also general or special. A general issue is where the defendant denies the whole, or the principal part, of the allegations of the plaintiff; a special issue is where some special matter, or material point, is in dispute between the two parties. When a special plea is pleaded, evidence [illegible] to the truth or falsehood of the [illegible] is the subject of that plea; but [illegible] the general issue, the plaintiff is usually compelled to prove his whole case to the satisfaction [illegible] and, at the same time, the defendant is en[illegible] prove any circumstances whatever which [illegible] liability. There must be in every issue an [illegible] on the one part and a denial on the other, and the negative should be as full as the affirmative. When either party admits the facts, but denies the law of the other, he is said to demur. The statements and counter-statements of the parties are called the pleadings. (*See* PLEADING.)

ISTHMIAN GAMES. (*See* GAMES.)

ITACOLUMITE, *i-tă-kol'-u-mite*, in Min., a micaceous, granular quartz rock, found in Brazil, in which gold and topaz are associated.

ITALIAN ARCHITECTURE, *it-al'-yăn*, a style of architecture founded on the old Roman orders, and the characteristic features of the ancient buildings of Rome, which may be considered to have been initiated in Italy by Brunelleschi and the Italian architects of the day, in the 15th century, and brought to perfection by Palladio and other architects of eminence, in the 16th century, who flourished in the times of the Medici. In buildings designed both for public and private purposes, it is chiefly characterized by the use of the Roman orders of architecture, rather as decorative than constructive features. These are mainly obtained by the use of pilasters placed along the façade of each story of a building at intervals, each row of pilasters being surmounted by an entablature running along the entire length of the edifice, like a string-course. When engaged columns, or columns attached to the wall, and projecting from its face to the extent of one-half or three-fourths of their diameter, were used, the entablature was broken over each column, to prevent the heavy appearance that it would have presented if it had been of the same depth throughout; and this was frequently done in the case of pilasters. The cornices of the entablatures were richly ornamented. The windows and doors were decorated with pilasters or columns, rising from a massive and projecting sill, and surmounted by circular, pointed, or broken pediments, on which recumbent figures were frequently placed. The roof was partially hidden by a balustrade, which crowned the edifice, and rose above the attic story, and the pedestals of the balustrade generally supported statues or sculptured vases. (*See* BALUSTRADE.) In this, and other respects, Italian architecture seems to bear some slight affinity to the architecture of the Elizabethan period; for, in both styles, the stories are divided by entablatures supported on pilasters, and carved ornaments are introduced on the summit of the buildings in each. Here, however, all resemblance ends, and these points of similitude are merely suggested here, to show that similarity of treatment may be frequently traced in the styles of architecture prevailing in different countries at the same period; although there is no reason to suppose that the architects who have developed and perfected either style have been influenced by the mode of treatment adopted by those who have originated the other. It was not until the 17th century, indeed, that the style of architecture that had prevailed in Italy during the previous century was followed and copied in England. Many of the buildings erected during the reigns of the monarchs of the house of Stuart, by Inigo Jones and others, present good examples of this style; among which may be mentioned the Banqueting-house at Whitehall. Somerset-house, built after designs by Sir William Chambers, in 1775, and many of the modern club-houses, as those belonging to the Carlton, Reform, and Travellers' clubs, are also built after this style.

ITALIAN LANGUAGE AND LITERA[illegible] are many doubts as to the exact origin of the Italian language, and in fact the era of its birth [illegible] be lost in obscurity. Some writers on the [illegible] to think that the harmonious [illegible] Italy had originated from [illegible] the [illegible] to Latin with the barbarous [illegible] tribes [illegible] overran Italy after [illegible] subject, however, is fully inquired [illegible] that this opinion is nearly, if not [illegible] for it will be seen, on reference to [illegible], that after

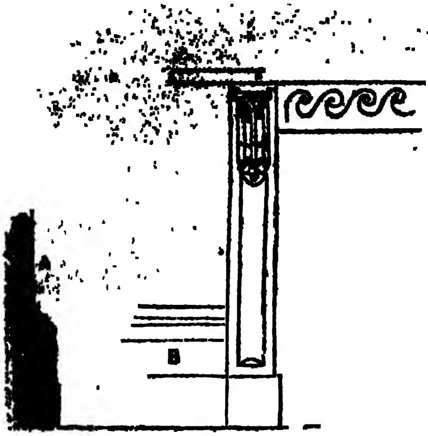


Fig. 4.

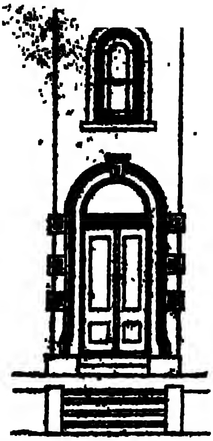


Fig. 5.

In the accompanying engravings of portions of a structure in the Italian style, [illegible] 1 shows the elevation of a sculptured pilaster, formi[illegible] part of a chimney-jamb. Fig. 2 is the front elevation of a bay-window, the plan of which shows the three sides of an octagon, with the bedroom window over it. The side elevation of the bay-window is shown in fig. 3. A fireplace is exhibited in fig. 4; A shows the profile of the skirting-board running round the room, of which the lines at B show the front elevation. Fig. 5 is the front elevation of a door, with vermiculated dressings; fig. 6 shows the front elevation of a Venetian or three-light window on ground-floor, with bedroom-window over it, with ornamental dressings and segmental pediment; fig. 7 is the elevation of a bay-[illegible]dow, with bedroom-window over it. (*See* Plates [illegible]II. to LXXIV.)

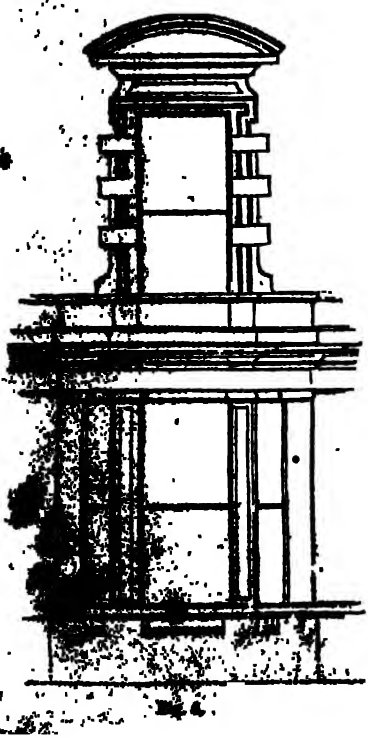
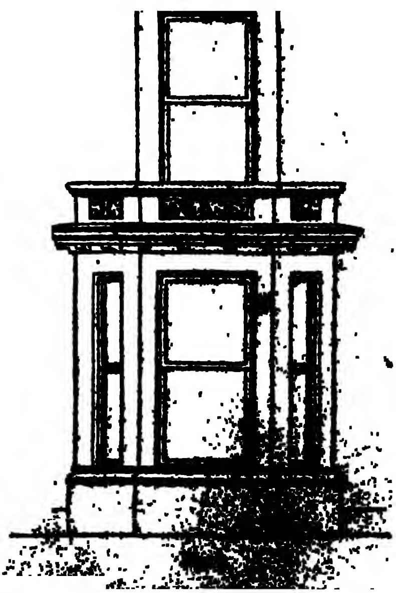


Fig. 6.



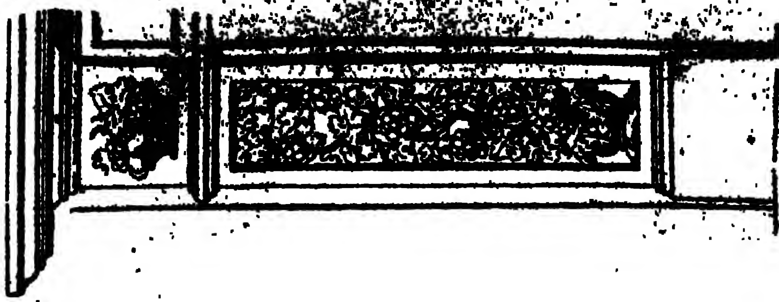
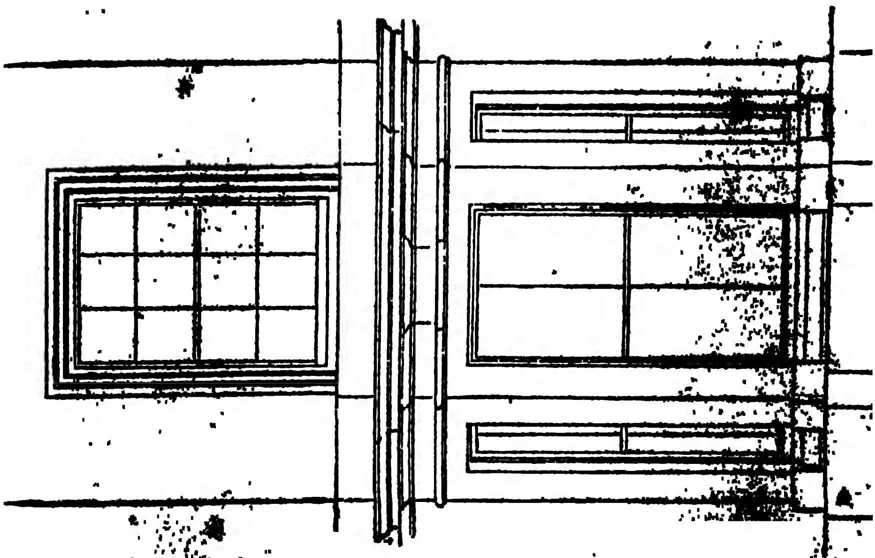
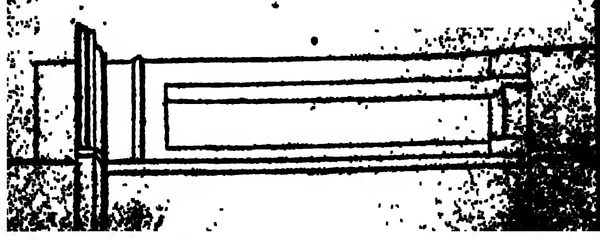


Fig. 1





the departure of the Huns, the Goths, and Visigoths, Latin was spoken and written in the middle ages prior to the revival of learning, with a grade facility which tend powerfully to impress us with the conviction that there could not have been much intermixture of foreign tongues with the Latin, at least of the educated classes. It must be borne in mind, nevertheless, in considering this point, that the language of the literary and cultivated portion of the Italian community was not the language of the people taken as a whole, and that the latter was composed of many foreign elements. An Italian writer of the 15th century, Leonardo Bruni, surnamed L'Aretino, from his birthplace Arezzo, maintains the theory that the Italian language is coeval with the Latin, and that both were used at the same time in ancient Rome; the Latin by the learned and polished, and the Italian dialect by the common people. Two other writers, Cardinal Bembo and Francesco Saverio Quadrio, have maintained the same opinion since the time that Bruni wrote. To bear out this assertion, these writers cite the language used in the plays of Plautus and Terence by plebeian personages. There they find many words [illegible] sions, which bear some resemblance to the [illegible] alian, and which have never gained admittance into the works of other classic writers; and from these examples, and from some interchange of letters, such as the use of *e for o*, as in *vestris*, for *vostris*, and *o for b*, as in *[illegible]*, for *bellum*, they draw the ready conclusion, that as the vulgar Latin was not classic Latin, it must have been Italian. The reader may judge from the following examples of words which are quoted by Quadrio to sustain his opinion:—

Vulgar Latin.	*Italian.*	*Classic Latin.*
Essere,	*Essere,*	Esse.
Vernum,	*Verno,*	Hyems.
Minacia,	*Minaccia,*	Minæ.
Batuere,	*Battere,*	Percutere.
Bellus,	*Bello,*	Pulcher.
Russus,	*Rosso,*	Rubeus.
Caballus,	*Cavallo,*	Equus.

From this list it will easily be seen that there are words now in use in the Italian language which were of old in the mouths of the Roman populace, and others which bear a much stronger resemblance to vulgar than to classic Latin. The only conclusion, however, that can be drawn from this evident similarity, is that there was a difference between the classic and the common language; beyond this, the arguments of the writers before mentioned can sustain no foundation. For, if the argument be found proved, it could be deduced from the same hypothesis, that the English language is essentially German, from the fact of many words in the two tongues being similar. The third theory on the subject of the origin of the Italian language is that of the Marquis Scipio Maffei. This writer rejects the opinion of Bruni and his disciples; for he reasonably lays down the argument, that "vulgarisms are not sufficient to form a language, nor to render it adequate to literature." He also rejects the theory first mentioned, that Italian was formed by the intermixture of the classic tongue with barbarous dialects; and the opinion he advances is, that the Italian language, as it stands at present, was formed by the gradual corruption of the classic Latin, without the intervention of any extraneous influence whatever. To quote Maffei, "It originated from abandoning, in common conversation, the classic, grammatical, and correct Latin, and generally adopting in its stead, a vulgar mode of speech, incorrect in structure and vicious in pronunciation." So much for the different theories on the subject. The first authentic specimen of the Italian language belongs to the close of the 12th century. It is a *canzone* of Ciullo d'Alcamo, by birth a Sicilian, and the earliest Italian poet whose name is on record. There is no doubt that the new language was opposed to the great variety of dialects that had grown into use after the invasion of the Northmen; but the formation of it was indeed slow, for the learned and the poets (from whom it was necessary for the infant language to receive its stamp and *entrée* into fashionable life) were averse to its introduction, as they deemed it a sorry scion of the classic Latin, which latter was esteemed, both for its age and for its recollections of former greatness, which the Italians were only too eager to maintain, after the downfall of their empire. Even at the present time, that idiom which we find in the better class of authors, and which charms us by its harmonious roll, is not to be found as the common idiom of the peasants in any part of Italy. From the 12th century to the close of the 13th, but little was done to ground the Italian language; but shortly after the latter period came the glorious epoch of Dante, Petrarch, and Boccaccio. Their praise is universally upheld by all writers, as men who initiated a new era for the Italian language and Italian literature. They were emphatically the giants of an early age, when gigantic strength was wanted to fix the uncertain foundations of their national language and literature on a scale broad and deep and massive. In the words of a critic on the subject, they did not strike the first spade into the soil, but they drew the stone from the quarry, set the landmarks, polished the rough marble, and piled and cemented the misshapen blocks, till beneath their hands the noble structure rose, majestic, towering, and beautiful. By such writers was the Italian language brought to the highest point of its literary culture before the close of the 14th century. From the commencement to the end of the 15th, and, indeed, until the middle [illegible]

[illegible] the writings of Dante, Petrarch, and Boccaccio, and the firm establishment of the Italian language as a complete whole, both in the literary world and amongst the people generally. The Italian language, as it at present stands, is essentially a Latin dialect, although somewhat changed in its grammar and construction, by the infusion of the modern spirit into the antique, as the character of the people underwent the same change. There are seventeen leading dialects in the Italian, which may be ranked in the following order:— the Sicilian, the Calabrian, the Neapolitan, the Roman, the Norcian, the Tuscan, the Bolognese, the Venetian, the Friulian, the Paduan, the Lombardian, the Milanese, the Bergamask, the Piedmontese, the Genoese, the Corsican, and lastly, the Sardinian. Of these the Sicilian is the first of the Italian dialects which was converted to literary uses; and it may be, in fact, called the mother tongue of the Italian muse, as Sicily is generally called her cradle. It exhibits traces, more or less, of the different dominant rulers of the island, and words may be clearly discovered which are undoubtedly of Grecian, Carthaginian, Roman, Byzantine, Arabian, Norman, German, French, and Spanish origin. The peculiarity in the Sicilian dialect consists chiefly in the use of *u for o, i for e*; as *timu for temo*; *culuriu* for *colorito*; *un for uno*; and in many other instances too numerous to mention. It would be impossible, within the limits of the present article, to touch in detail upon the different dialects individually. A few general remarks will suffice instead. The Florentine is that in which the greatest portion of the literary monuments of Italy is written, in consequence of the great poets and other authors being born at Florence, and hence using their native dialect. But there cannot be much doubt that the classic Italian tongue is based principally on the Tuscan dialect, which has done more to its formation than any other spoken throughout the length and breadth of Italy. The study of the language in modern times has much increased, and great pains have been bestowed on vocabularies, dictionaries, and other works of an educational class. Considered in any light, the Italian language is one of the most beautiful and harmonious of European tongues, and is rightly deemed to be the true medium for the interpretation of real poetic feeling. The liquid sound of the language is owing to the prevalence of labials and vowels throughout it, which, even in the roughest dialects, as in the Tuscan, which is more composed of gutturals, combined with the soft pronunciation peculiar to the south of Italy, renders the Italian language the most euphonious in Europe —indeed, in the world. To turn to the second part [illegible], at the com- [illegible] to the [illegible] ect. In [illegible] to the [illegible] s, embrace the

years between the era of Charlemagne and the peace of Constance in 1183, not much was done in Italy towards the spread of literature, the principal authors being not of much influence, either in a philological or ethical point of view. They are as follows:—In theology: the popes Eugene, Adrian I., Leo V., Nicholas I., and Sylvester II.; also Paulinus, patriarch of Aquileia, and Theodolphus, bishop of Orleans. In the second period, the principal theologians were, Fulbert, bishop of Chartres, and the two celebrated archbishops Lanfranc and Anselm. Among the historians, both of the first and second periods, may be mentioned Diaconus, Andrew of Bergamo (author of a Chronicle of Italy from 868 to 875), Leitprandus of Pavia, Amalphus, Sire Raoul, and many other obscure writers, too numerous to mention. In the third period, from the peace of Constance to the end of the 13th century, literature gradually underwent a change, which was, step by step, leading to a more pleasing aspect. Attempts were now being made to write works in the *lingua volgare*, instead of in barbarous Latin, and everything pointed on to the glorious era of Dante, and the enlightened school which he was the means of establishing. The emperor Frederick I. may be said to be the prime mover in this desire for enlightenment, and his court was thronged by the learned in every branch, either of science, of art, or of literature. In philosophy, the most celebrated man we meet with in this era is Thomas Aquinas, who wrote a commentary on the works of Aristotle. In mathematics, Campano wrote a commentary on the works of Euclid, and many others, as Lanfranco, Leonardo, and Guido Bonatti, followed in his footsteps. The study of law became also greatly improved. In history, the name of Matteo Spinello must be honourably mentioned, as he wrote the first lengthy and complete work in Italian prose. Brunetto Latini, the instructor of Dante, must likewise not be passed over with neglect. The fourth period, which embraces the whole of the 14th century, is, however, the grandest, as it is the starting-point in the real history of Italian literature. Albert of Padua, Gregory of Rimini, Bonaventura of Perugia, and Ludovico Marsigli, are the theologians of this period. Petrarch is the real philosopher of the times, who does honour to his country, and he wrote numerous Latin works on moral subjects, which reflect the wisdom of his scientific brain. Paolo, surnamed Geometria, is said by Villani to be the first of mathematical discoverers, and he likewise lived in this century. In history we have also Petrarch, who wrote the "Rerum Memorandarum;" and Boccaccio, who was the author of "De Genealogia Deorum," and many other works. In this period also occur the first collection of Italian tales and romances; and here, again, we have to thank Boccaccio for his "Decameron" and "Fiametta," which will always be remarkable in literature. Dante, however, must be given the prime place in the literature both of this period and of his country in general. Of all his works, his "Divine Comedy" must rank highest; but he was also the author of the "Vita Nuova," the "Convito," and also his work, "De Vulgari Eloquentia" (in which he lays down the basis of the new Italian language), and his "De Monarchia." Hallam, in speaking of Dante, in his "Literature of Europe," says that Varchi, in a passage of the "Ercolano," having extolled Dante even in preference to Homer, gave rise to a controversy, wherein some Italian critics did not hesitate to point out the blemishes of their countryman. Bulgarini was one of these critics; and Manzoni undertook the defence of Dante

[illegible] are considering, much was done in his honour, and endeavours were made to further his attempts for benefiting his country in literature. In concluding this period, as is well said by an eminent authority, in the early part of the 14th century, according to Lord Macaulay, in his essay on Machiavelli: "The progress of elegant literature and of the fine arts was proportioned to that of the public prosperity. Under the despotic successors of Augustus, all the fields [illegible] intellect had been turned into [illegible] out by formal boundaries, still [illegible] old cultivation, but yielding neither flowers nor fruit. The deluge of barbarism came. It swept away all the landmarks, it obliterated all the signs of former tillage; but it fertilised while it devastated. When it receded, the wilderness was as the garden of God, rejoicing on every side, laughing, clapping its hands, pouring forth, in spontaneous abundance, everything brilliant, or fragrant, or nourishing. A new language, characterised by simple sweetness and simple energy, had attained perfection. No tongue ever furnished more gorgeous and vivid tints to poetry; nor was it long before a poet appeared who knew how to employ them. Early in the 14th century came forth the 'Divine Comedy,' beyond comparison the greatest work of imagination which had appeared since the poems of Homer. The following generation produced, indeed, no second Dante; but it was eminently distinguished by general intellectual activity. The study of the Latin writers had never been wholly neglected in Italy. But Petrarch introduced a more profound, liberal, and elegant scholarship, and communicated to his countrymen that enthusiasm for the literature, the history, and the antiquities of Rome, which divided his own heart with a frigid mistress and a more frigid muse. Boccaccio turned their attention to the more sublime and graceful models of Greece." We pass over the fifth period, which lasts from 1400 to 1500, and enter upon the sixth, or 16th and 17th centuries, which is the most glorious of any in the literary history of Italy. The power of her republics and the magnificence of her princes had done much to restore the former splendour and greatness of the country, and Italy could well, at the time of which we are speaking, point proudly to herself as an example for the rest of Europe to follow. The number of academies and libraries had increased to such a degree, that few, even of the small cities, were without them, and learning, and a fostering of the arts, had spread likewise in a proportionate manner. Among the popes there were many who promoted this general desire for improvement; and the names of Julius II., Leo X. (the Magnificent), Gregory XIII., and Urban VIII., well deserve the prominence they occupy in history, even on this account alone. Next must the princes be mentioned; for they were by no means behindhand with the popes in their activity for the spread of literature. Among these latter we come across the names of Gonzaga of Mantua, the Prince d'Este de Ferrara, the Medici of Florence, and Duke Charles Emanuel of Savoy. In history much was done, and well done too. Carlo Sigonio wrote a general history in Latin; Girolamo Briani a similar chronicle, but in Italian; Machiavelli, a "History of Florence," which latter must ever bear up the reputation of its author,—among many others who did something for history, but whose names even are too numerous to be even mentioned in the present article. In poetry, we have the honourable names of Bernardo and Torquato Tasso, (the former celebrated for his Letters and the latter for his Dialogues and Philosophical Essays); also Pietro Badoaro, a poet of no mean repute; Alberto Lollio and Claudio Tolommei, besides many others. The novelists of this period were numerous, indeed, and criticism was also beginning to be judiciously exercised, as we have evidence of, in the attack and defence of Tasso's "Jerusalem Delivered." During the seventh period, which lasted from 1650 up to the year 1820, much cannot be said to have been done for Italian literature,—the few names that occur, touching on the history of literature *per se*, being Crescimbeni, Quadrio Fontanini, A. Zeno, Mazzuchelli, Fabroni, Tiraboschi, and Comiani. Passing on to the last period, which embraces the years between 1820 and the present time, we must notice the decade of Italian literature, with, however, a hope of its rise again in future years, now that Italy has become once more a kingdom. The restraints which naturally arise in a country entrammelled by politics are undoubtedly one of the chief causes which have led to this fall, combined with the indolence induced by too warm a climate and one too favourable for idleness. [illegible] cause must likewise be noticed, and that is the [illegible] ment of the copyrights of one city by another,— [illegible] the greatest drawbacks to the spread of literature. [illegible] the writers of this period, few occupy any prominent [illegible]

place, with the exception of Andrea Maffei, who has done much, both by original works and translations, for the advancement of literature. In science and art, the 19th century has not been unproductive to Italy, but in poetry and literature there has been a sad falling off from the noble era ushered in by Dante. Perhaps it will not be out of place here to give a short glance generally at Italian poetry, which is, indeed, one of the most remarkable features in the literature of the nation. If we compare the literature of Italy generally with that of other European countries, we will find [illegible] for believing its characteristic peculiarity to consist in the sedulous cultivation and systematic moulding of the lyric. It is little to say that the number of lyrical poems written in the Italian language has been greater than the number of poems belonging to any other cultivated nation. The lyric, in one or another of its forms, is the vehicle of expression which naturally suggests itself to minds struggling rather to give vent to poetic feeling than to create works of poetic art. But it is a different thing to assert, what is equally true, that, by the Italians, the lyrical poem has been more thoroughly elaborated into a work of art than by the poets of any other country; and that, in the standard poetical literature of Italy, the lyric holds a more distinguished place than that which belongs to it in the poetry of any other Euro[illegible]pe. Of the pure lyric, the model was the [illegible] canzone, though several freer forms were allowed as occasional indulgences; the Sicilian sonnet, whose name has passed with its rules to other countries, was the recognized name of a mixed species, in which the lyrical poem was modified by elements borrowed from the didactic. Dante set his hand to the plough, and hosts of young poets followed in his footsteps, anxious to cultivate the soil thus left open to them. It was thus that the poetical literature of Italy put on the aspect of a garden, boasting, indeed, but a few magnificent specimens of those lordly plants that need ample care as well as a kindly climate and a genial soil, but glowing everywhere with the fragrant loveliness which skilful culture imparts to the native wild flowers of the meadow and the wood. So much for Italian poetry. The best references on the language, literature, and poetry of Italy, are as follows:—Quadrio, *Storia d'ogni Poesia*; Maffei, *Verona illustrata*; Nardini, *Saggi di Prose e Poesie de' più celebri Scrittori d'ogni Secolo*; Monti, *Amor Patrio di Dante*; Dante, *De Vulgari Eloquentia*; Machiavelli, *Discorso in cui si esamina se la lingua in cui scrissero Dante, il Boccaccio, e il Petrarca, si debba chiamare Italiana, Toscana, o Fiorentina*; Ginguène, *Histoire Littéraire d'Italie*; Sismondi, *De la Littérature du Midi*; Corniani, *Secoli della Letteratura Italiana*; Hallam, *Introduction to the Literature of Europe*; and Brockhaus' *Conversations Lexicon*.

ITALIAN MILLET. (*See* SETARIA.)

IONIAN PHILOSOPHY. (*See* GREEK PHILOSOPHY.)

ITCH, *itsh* (Ang.-Sax.; Lat. *scabies*, from *scabo*, I scratch), in Med., a disease of the skin, characterised by an eruption of pustules or of small vesicles, the two being frequently intermixed, and accompanied by an intolerable itching; whence it derives its name. It has been divided into different classes; but the [illegible] is of no practical importance. It occurs chiefly about the fingers and the wrists and the [illegible]rs of the joints; but it may also attack other parts of the body, the face being the only [illegible] on which it never appears. It is caused by a [illegible] insect—the *Sarcoptes scabiei*—lodging under the [illegible], and is readily communicated by contact. The itch [illegible] er got rid of without medical treatment, and the [illegible] specific for its removal is sulphur. It is com[illegible] used in the form of an ointment, smeared over the part once or twice a day, washing it carefully with soap and water before each fresh application. The cure usually takes from three to eight or ten days, according to the nature and extent of the disease.

ITE MISSA EST, *i'-te mis'-sa est* (Lat., Go, it is dissolved), in the Roman Catholic church, is a formula by which, on joyful feasts, the end of low mass is announced to the people, and the assembly is dismissed. The priest steps into the centre of the altar, and sings these words after the *Deus vobiscum*.

ITINERARY, *i-tin'-e-ra-re* (Lat. *iter*, a journey), in Lit., is the name given to a work containing a list of the stations and halting-places on a road between two places, with a statement of the distances between them. Of the most important itineraries of antiquity are 1. the *Itineraria Antonini*, including the *Itinerarium Provinciarum*, or a list of the routes through the Roman provinces of Europe, Asia, and Africa, and the *Itinerarium Maritimum*, exhibiting the most frequented tracts along the coasts and at sea; and, 2. the *Itinerarium Hierosolymitanum*, made by a Christian in A.D. 333, for the use of travellers from Burdigala (Bordeaux) to Jerusalem. The edition of these itineraries by Pinder and Parthey (Berlin, 1848) has superseded all others. Itineraries of districts little known, or unknown to Europeans, are of importance to geographers and the makers of maps; as are, for our knowledge of the ancient world, the itineraries of antiquity.

ITIS, *i'-tis* (Gr., from *iemai*, denoting violent or impetuous action), in Med., is a termination added to the genitive case of the Greek name of an organ, to indicate inflammation of that part; as, *gastritis*, *hepatitis*, *carditis*; meaning inflammation of the stomach, liver, or heart.

IVORY, IVORY MANUFACTURE, *i'-vo-re* (Fr. *ivoire*), the substance which composes the teeth or tusks of elephants. Ivory is largely used in the arts for making or ornamenting a great variety of small articles in general use. The west coast of Africa and Ceylon are the districts from which the principal supplies of elephants' teeth to this country are obtained. The Cape of Good Hope, Madagascar, Siam, and the coast of Barbary, also supply us with ivory. Fossil ivory is also sometimes exported from Russia to England. The trade in ivory has greatly increased of late years, and as much as £20,000 worth is sometimes shipped from Alexandria in one cargo. This portion of the trade chiefly consists of wild elephants' tusks, which have been shed in the Arabian deserts, and bought up by the pacha of Egypt for sale in England. Although the ivory made from elephants' tusks is the best, varieties are also made from the teeth and tusks of the hippopotamus, wild boar, and narwhal. The fossil mammoth of Siberia furnishes the Russians with a kind of ivory very similar to that furnished by the elephant of the present day. Mammoth tusks are sometimes obtained ten feet long, weighing nearly 170 lbs., and solid to within six inches of the end. The white keys of pianofortes are frequently veneered with this kind of ivory. For manufacturing purposes, ivory is cut up by means of saws with sharp but coarse teeth, set in steel frames. Great art is required in cutting the tusks, as their peculiar turns and twists render them liable to be cut to waste. Veneers can be cut in a ratio of thirty to an inch thickness of ivory; and as the sawdust and scrapings afterwards effect a waste of one half, it frequently happens that sixty finished ivory veneers will not be more than an inch in thickness. These thin plates are principally used for painting miniatures upon, and making memorandum-books. Ivory forms a fine and delicate substance for making graduated scales for mathematical instruments. It is liable, however, to expansion and contraction in changes of weather. After being cut with the saw, ivory is smoothed and polished in a variety of ways. Fine glass-paper is sometimes used; at others, emery-paper, whiting and water, oil on a piece of rag, putty-powder, Flanders brick, powdered chalk, &c. It is also sometimes scraped and rubbed on list wheels, consisting of ten to twenty circular pieces of woollen cloth screwed tightly between two wooden discs of rather smaller diameter: the cloth forms a pliant edge projecting beyond the wood. Such wheels, when moistened with Trent sand, are used for polishing parasol handles and similar articles. The chief consumption of ivory in England is in the manufacture of knife-handles and combs. Ivory is frequently engraved by French artists. Having covered the surface with a wax or composition coating, they etch the design in it, by means of a dilute solution of nitrate of silver; the etching is then bitten in, the whole washed in distilled water, dried with blotting-paper, and exposed to the sun's rays. When the ground is [illegible] is seen as a series of brownish lines, [illegible] speedily [illegible] a black. Sometimes the ivory is itself engraved, and the lines filled [illegible] with hard black varnish. Hitherto, no European

artist has been able to cut concentric balls of ivory after the manner of the Chinese; and their boxes, chessmen, and other ivory articles, far surpass those of any other nation. *Vegetable ivory*, as it is called, is the seed of a genus of plants named *Phytelephas* (Gr. *phuton*, a plant; *elephas*, ivory), occurring in South America. The natives have used these seeds from time immemorial for making buttons, heads to walking-sticks, and various trinkets. It is only within a recent period that they have been brought to Europe. They are not so useful as ivory for delicate purposes; but they are used in the manufacture of a number of articles.

IVORY, ARTIFICIAL.—The best imitation, the kind now much used, is made by dissolving either caoutchouc or gutta-percha in chloroform, passing chlorine through the solution, until it has acquired a slightly yellow tint, washing it well with alcohol, then adding in fine powder, sulphate of baryta, sulphate of lime, sulphate of lead, alumina or chalk in quantities proportioned to the density and tint required; then hardening it, and, finally, subjecting it to heavy pressure. An ivory-like substance is thus made, which is of great hardness, and will receive a high polish.

IVORY-BLACK.—When bone is burnt, it forms a mixture of charcoal and phosphate of lime, which is sold under the name of ivory-black. Like other forms of animal charcoal, it is very effective in depriving certain substances of their colour and odour. When ivory-black is prepared by calcining the shavings and dust of ivory, and then ground and levigated on a porphyry slab, it gives the velvety-black material which forms the principal ingredient of the ink used in copper-plate printing.

IVY. (*See* HEDERA.)

IXOLYTE, *iks'-o-lite*, in *Min.*, mineral resin of a hyacinth-red colour, found in Austria, in amorphous lumps, amongst the tertiary lignites. It softens at 169° Fahr., and remains viscid at 212° Fahr.

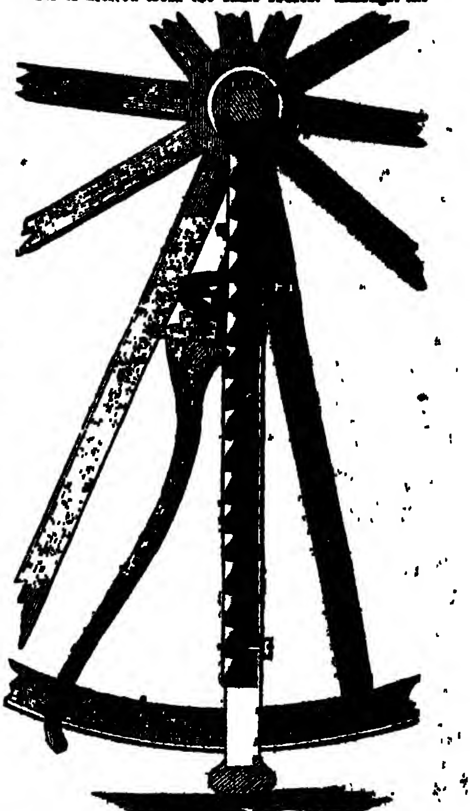
J.

J is the tenth letter and the seventh consonant in our alphabet. Its sound in English resembles that of *dzh*, and in French it has the sound of *zh* or *zh*. In German, however, it is always pronounced like our *y* before a vowel; as *ja*, pronounced *ya*. In Spanish it is a guttural, a little softer than the *ch* in *ach*. Its pronunciation in Latin is disputed; but there is reason to believe that the English sound was not unknown to them; for, originally, Jupiter was written *Diupiter*, and Janus, *Dianus*. The distinction in form between I and J is only of recent date, and in dictionaries down to lately the two were intermixed.

JACAMAR, *jăk'-ă-mar* (*Galbula*, Brisson), a name applied to a gen. of birds belonging to Cuvier's third order, *Scansores*, or climbers. These brilliant birds are closely allied to the kingfishers, by their elongated, sharp, quadrangular bill, and by their short feet, whose anterior toes are for the most part united; nevertheless, these toes have not the same formation exactly as in the kingfishers. The plumage also of the jacamars is not so smooth as that of the kingfishers, and has always a metallic lustre, which it is almost impossible to imitate by art. They live solitarily in humid woods, feed on insects, and build their nests on low branches. Most of the true jacamars are natives of tropical America. There are some found in the Indian Archipelago, whose bill, shorter, thicker, and a little bent, approximates them to the bee-eaters. To these Le Vaillant has given the generic name of Jacamerops.

JACK, *jăk*, in *Mech.*, a sort of crane for lifting heavy weights. It consists of small pinions worked with a common winch. The pinion works in the teeth of a large wheel, on whose axis there is fixed a small pinion with teeth working in a rack. By turning the pinion, the rack is raised, and with it any weight attached to it. If the length of the handle of the winch be seven inches, and the pinion which it drives contains four leaves, working in the teeth of the large wheel, having twenty teeth, then five turns of the handle will cause one revolution of the wheel. But the length of the arm of the winch being seven inches, the circumference through which the handle moves will be about forty-four inches, and from one turn of the wheel the handle must pass through $5 \times 44 = 220$. Say that the wheel carries a pinion of three leaves of a pitch of one-third of an inch, working the rack that carries the weight, one turn of the pinion will therefore raise the rack one inch, and 220 will be the power of the jack, as the power moves through 220 in the same time. Figs. 1 and 2 depict a plan of a jack-screw for turning large stones. This most ingenious machine was employed in the construction of the United States dry dock at Brooklyn.

JACK.—This nickname, or diminutive for the name John, is used in various ways. It is difficult to explain why, in the principal modern languages, *John*, or its equivalent Jack, is a name of slight or contempt. The Italians use the word *Gianni* in this sense; from which *Zani* is derived. Amongst the Spaniards, *bobo Juan*, foolish John, and the French *Jean*, have a similar signification. The term Jack-fool is used by Chaucer, as the *bobo Juan* of the Spaniards; and probably Jackass is derived from the same source. Amongst the



JACK LEVER.

Germans, *Hans*, the nickname for John, is used in the same way; as, *Hans Narr*, Jack-fool; *dummer Hans*, stupid Jack, &c. It is also singular that most nations give the name of their favourite dish to the mountebank's

jesting attendant. Amongst the Italians he is called *Maccaroni*; among the Dutch, *Pickel-herring*; among the French, *Jean potage*; among the Germans, *Hans Wurst*, Jack sausage; and amongst the English, *Jack pudding*. In England, also, *Jack Ketch* has long been the generic nickname for the hangman. The terms boot-jack and roasting-jack seem to have been derived from the circumstance that boys were formerly employed to pull off boots and turn spits. Many of these boys had the common name of Jack; hence, when instruments were invented for these purposes, the common name of the boys was applied to them. The ordinary *roasting-jack* used for turning a spit consists of a double set of wheels, a barrel, round which the chain attached to the weight, or moving power, is wound; a perpetual screw, and a fly, which secures a steady uniform motion. Occasionally a multiplying wheel is added, in order that the weight may be longer in running down. The *smoke-jack* is used for the same purpose as the roasting-jack, and is so called because it appears to be moved by the smoke in the chimney. It is in fact moved by means of a fan placed horizontally in the chimney, which is carried by the current of heated air from the fire. It requires no machinery to wind it up, and the motion may be obtained in various ways. Sometimes spiral fliers, coiling about a vertical axle, are used, and sometimes a vertical wheel, with sails like the float-board of a mill. In former times, the term *Jack* was applied to a coat of mail; and *jack-boots* were large boots to cover the legs. It has also several other diverse applications; thus, it signifies a horse or wooden frame to saw timber on; a large leathern pitcher, in which drink was formerly put; the small bowl which is used as a mark in the game of bowling; and also a young pike. In sea language, a *Jack* is a sort of flag displayed from a mast at the outer end of the bowsprit of a ship.

JACK LEVER.—The lever carriage-jack represented in section in the accompanying figure, is adapted for raising weights by the action upon the rack of the teeth on the end of the lever. The shank by which the lever is suspended is seen between the lever and the sliding-catch, which sustains the rack when it has attained the required height, and between the downward strokes of the lever. When it is desired to lower the rack, the lever is still further depressed, raising the rack off the catch, withdrawing the catch, and then bringing the lower stud, as seen in the engraving, in contact with the rack, throwing the teeth out, and bringing any desired amount of pressure on the neck, allowing it to descend gently. The jack is shown as in the act of lowering, the teeth of the pinion and the catch being removed from the rack, and the lower stud pressing against it. This carriage-jack is the invention of two American gentlemen, Messrs. Clinton Knight Bros., of Cincinnati, Ohio.

JACK. (*See* PIKE.)

JACK TRAVERSING-SCREW.—Fig. 4, Plate LXVI., exhibits a side view and plan of the screw modification. The screw-jack A is bolted to the plank C; at the other end of the plank is fixed the rack G, in which the toe of the strut advances as the screw B is elevated; the strut works in a joint in the follower K; the position of the strut when the screw is depressed is shown by the dotted lines. The object of this strut is to relieve the screw of the violent cross-strain to which the apparatus is subject when the engine or carriage is pulled over by the lever, which strain is entirely transferred to the strut, and the screw has merely to carry the load. The operation of the traversing-jack is as follows: by hooking the link I upon the hook of the lever E, the toe of the lever being inserted into a ratch of the rack H of the lower plank, when a man bear-

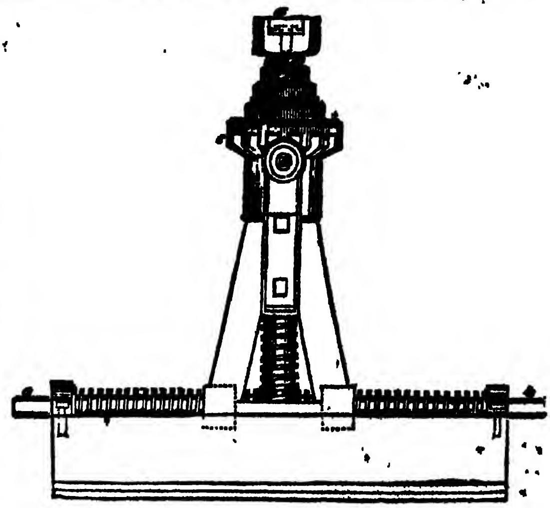


Fig. 1.

ing down the end of the lever, drags the apparatus or engine, or carriage, towards him with great facility: the same lever is used to turn the screw and to produce the traverse motion. By this apparatus an engine of 16 tons weight has been replaced upon the rails in five

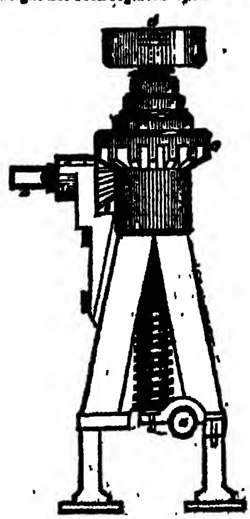


Fig. 2.

minutes by the engineer and stoker alone. The apparatus is exceedingly portable and cheap. [illegible] form of traversing-jack is here shown at fig. 1, side elevation, fig. 2 end elevation, and fig. 3 section [illegible]

vertical screw. The lift of this jack is effected by means of a crank, or lever, applied to the [illegible] which works the bevel-gear [illegible] cut on the projecting [illegible] of this nut lifts or lowers the vertical screw, and with it the jaw *b*; the [illegible] moving freely in a socket of the jaw-head, permits the latter to rise or fall with-

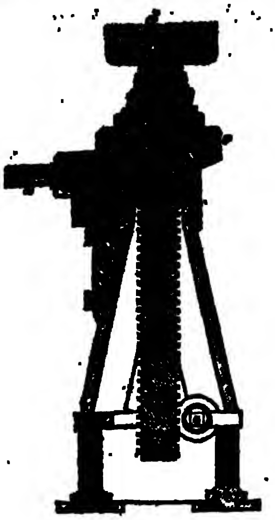


Fig. 3.

out side movement. The horizontal screw *a a*, working into a nut in the foot of the upper screw-frame, effects the horizontal or traversing movement of the jack, the frame of the lower screw serving as a bed or slide for the latter movement. A ratchet-lever may be used to work either of the screws, and with more effect than the simple crank. This jack is used in [illegible] and cars on the railway. [illegible] T., represent a plan of a screw-jack for turning large stone used in the U.S. dry dock at Brooklyn.

JACKAL, *jăk'-awl* (Arab. *tschakkal*, Fr. *chacal*), a species of wild dog, the *Canis aureus* of Linnæus. The dental formula of the jackal is that of the dog. The pupil of the eye is round, like that of the dog and wolf. In colour it is yellowish grey above and whitish below; the thighs and legs are yellow, the ears ruddy; the muzzle very pointed; the tail hardly reaching to the heel. The jackal is gregarious in its habits, hunting in packs, frequently attacking the larger quadrupeds, but more commonly preying on the smaller animals and poultry. Its cry is very piercing and peculiar, and travellers describe it as being somewhat [illegible] heard for the first time at night. Says [illegible] in his remarks upon this animal, [illegible] a sound which partakes less of har[illegible] at present in question; and, [illegible] burst of the answering long-pro[illegible] ceeding immediately to the opening [illegible] is scarcely less impressive than the roll of the [illegible] immediately after a flash of lightning. [illegible] this music is very much increased when [illegible] is heard in the distance (a circumstance which often occurs), and the answering yell bursts out from several points at once, within a few yards or feet of the place where the auditors are sleeping." Jackals are said to devour the corpses left on the field of battle, and to scratch away the earth from shallow graves, in order to feed on dead bodies. The belief [illegible] probably arose from the [illegible] gives notice [illegible] The disagree[illegible]

able odour of the jackal is one of the reasons why it has not been reduced to a state of domesticity. It is [illegible] of Asia and Africa. It is believed [illegible] the three hundred foxes between which Samson is said to have put firebrands, in order that they might set fire to the crops of the Philistines (Judges [illegible]), were jackals.

JACKDAW, *jăk'-daw* (Ang.-Sax.) (*Corvus Monedula*, Linn.), a common English bird of the crow kind, very much resembling the rook, particularly in its sociability. Jackdaws live together in considerable numbers throughout the year, and, whether seeking for food or rearing their young, they always appear to live in perfect harmony. The length of the jackdaw is about thirteen inches, with a black bill and white eyes; the hinder part of the head and neck of a hoary-grey colour; the rest of the plumage of a rich glossy black above, beneath dusky; the legs are black. The jackdaw is much more bold and familiar than the rook, approaching nearer to the residence of man, and sometimes taking shelter under his roof. It has also an aspect of greater cheerfulness, and there is activity in its movements. Cultivated districts are preferred by jackdaws, and they frequent and build in church towers, belfries, and steeples. The female lays from four to six eggs: these are usually produced in May, and the young are hatched by the end of the month, or early in June. The eggs are of a pale bluish-white, spotted with ash-colour and dark-brown. The young birds are easily tamed, and become much attached to those who feed them. Very soon they begin to imitate the sounds of the human voi[illegible] exhibit other amusing qualities. These birds [illegible] not particular as to the quality of their food, eat [illegible] discriminately, insects, seeds, grain, [illegible] on the sea-shore shell-fish, or the [illegible] fish, and crustacea. They may be seen [illegible] backs of sheep, gathering wool for their nests, or picking out parasitic insects. Jackdaws are notorious thieves, not only stealing food, but appearing to have a particular predilection for shining substances, as money, &c. On account of this propensity, they have frequently occasioned suspicions of theft in persons who were afterwards proved innocent. They carry this little weakness so far, that they have been known to purloin spectacles from persons who were in [illegible] of reading. The jackdaw is not only [illegible] country, but also farther north, [illegible] Scandinavia, in Russia, Western [illegible] It does not exist in America, but [illegible] Germany, France, Italy, and [illegible] Africa. It is also found at [illegible] Crete.

JACKET, STEAM.—The cylinders of [illegible] of the larger size are encircled with another cylinder of greater diameter, steam being [illegible] between them in order that the inner cylinder may be kept warm. This outer cylinder is called a jacket. This arrangement is not accompanied [illegible] great economization of fuel, and, besides, the engine-room is kept uncomfortably warm. A be[illegible] arrangement is to make the space between the [illegible] jacket air-tight, and to admit no [illegible] high-pressure engine, working with [illegible] perature of 300° Fah., the loss of pow[illegible] of cylinders without a jacket does [illegible] than $\frac{1}{15}$th part of the original [illegible]

JACK-FRUIT. (*See* ARTOC[illegible])

JACOB RIFLE, *jai'-kob*, a [illegible] rifle a[illegible] and perfected by the late G[illegible] of the [illegible] Irregular Horse, after mak[illegible] series of experiments at Jacobabad, in [illegible] repeated trials, General Jacob [illegible] that the best method of rifling th[illegible] was to cut four grooves in the [illegible] depth, each being about the [illegible] ference of the interior of the [illegible] other words, equal to the lat[illegible] rels of the most effective [illegible] Jacob's principle are 24 i[illegible] gauge, or ·526 of an inch in [illegible] four-fifths of a turn in the [illegible]

The weight of a barrel of this [illegible] and calibre should not be less than 4 lb., [illegible] necessary to [illegible] [illegible] its [illegible]

[illegible] but [illegible] with a spherical base and [illegible] cast about the base as before. A modification of this form of bullet was subsequently [illegible], the outline of the head being [illegible] of straight lines, and the [illegible] in such a manner that they formed four [illegible] about the hemispherical base, the [illegible] of which were of very little width, and [illegible] into the grooves by the force of the [illegible] would tend to diminish the windage. [illegible] of the ball used for a rifle of 32 gauge [illegible] inch, and its weight is 225 grains. General [illegible] invented a kind of rifle-shell, somewhat [illegible] in construction and purpose to those which [illegible] by Captain Norton. They were cast on [illegible] as the bullet, but with a deep hole at the upper end, in which a copper tube filled with detonating powder was inserted. Although excellent shooting has been made with rifles grooved on General [illegible] principle, the depth of the grooving seems to be an objection, as it reduces the strength of the barrel unless it be made of great weight and thickness, and [illegible] the formation of projection on the ball, besides rendering the rifle tedious to load.—*Ref.* Busk's *Rifle, and How to Use it.*

JACOBINS, the most celebrated of the clubs of the first French revolution. It originated in the *club Breton*, formed on the opening of the States-general at Versailles, in 1789, by the deputies from Brittany. On the removal of that assembly to Paris, this club established itself in the Rue St. Honoré, in the old convent of [illegible], or Jacobins. They admitted any [illegible] by four members, and assumed the [illegible] *Société des Amis de la Constitution*, better [illegible] from their place of meeting. They [illegible] numerous; deputies, and all desirous [illegible] seeking to join them. Every [illegible] or motion, before being submitted [illegible] Assembly, was here debated by the [illegible], each anxious for the favour of the [illegible] the club became the controlling [illegible]. Extreme opinions gaining the [illegible] and more moderate members [illegible] the *Société de* 1789, or *des Feuillants*; the [illegible] was to render the Jacobins [illegible]. Their influence extended [illegible], and in 1791 they possessed 1,200 [illegible] which obeyed orders from head-quarters in Paris. In May, 1791, the *Journal de la* [illegible] *de la Constitution* was established, and [illegible] revolutionary principles to every [illegible] kingdom. They were foremost in the [illegible] movements of June 20 and August 10, [illegible] *Commune de Paris*, and [illegible] *Amis de la Liberté et de* [illegible] this time they ruled supreme, even [illegible] itself. Robespierre's political [illegible] with them, and with him their [illegible] Thermidor. The terror they had [illegible]; and on the 9th November, 1794, [illegible] the *jeunesse dorée*—attacked [illegible] the Convention decreed [illegible] meetings and the closing of [illegible] were made, however, by the [illegible] to regain influence, by establish [illegible] *Manège*, and then the *Club de la* [illegible]

[illegible] a party in Great Britain who, [illegible] 1688, adhered to the cause of [illegible] II. and his descendants. [illegible] powerful in Scotland, and [illegible] century continued to conspire [illegible] house of Stuart. They [illegible] 1715, and again in 1745. [illegible] as a party may be dated from [illegible] Charles Edward, in 1788, [illegible] ceased to be formidable. [illegible] a Christian sect in the [illegible] Syria and Mesopotamia.

[illegible] derive their name from Jacobus Baradæus, bishop of [illegible], who, in the 6th century, established a permanent [illegible] organization among the Monophysites [illegible] that the divine and [illegible] nature in Jesus Christ were so united as to form only one nature. At the death of Baradæus the sect was very numerous in [illegible] and also in Egypt, where they formed the nucleus [illegible] the present C[illegible] church. The Asiatic Jacobites number about 200,[illegible], governed by two patriarchs, one at Diarbekir, the other at Mardin. They practise circumcision before baptism, and in their church services use the obsolete Syriac language.

JACOBUS, *jāk-o'-bus*, a gold coin of the value of twenty-five shillings, and so called from King James I. of England, in whose [illegible] it was struck. Two kinds of jacobus are [illegible] distinguished as the old and the new. The former weighed six pennyweights ten grains, and had a value of twenty-five shillings; the latter weighed five pennyweights twenty grains, and was only valued at twenty-three shillings; it was sometimes called a *carolus*.

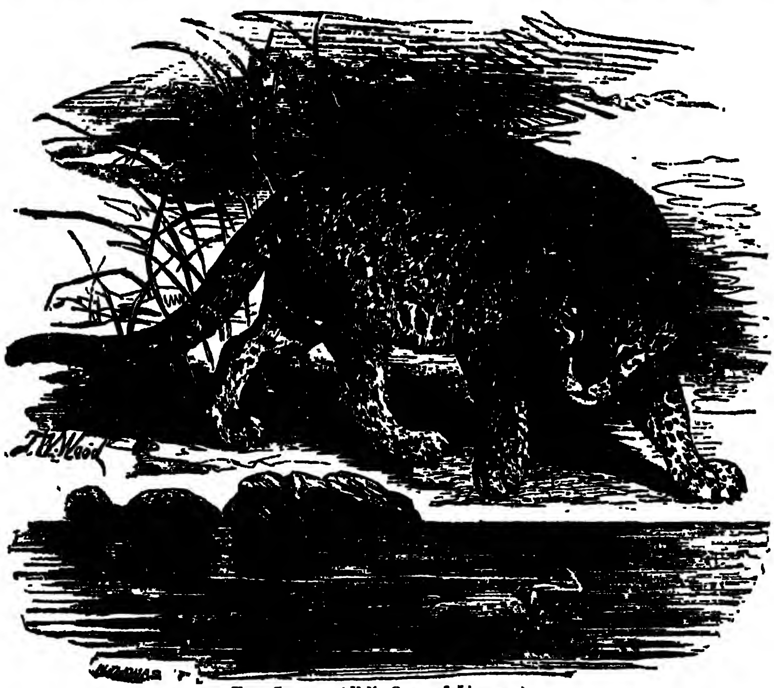
JACQUARD PERFORATING-MACHINE is the name given to a most excellent piece of mechanism, made at the factory of Messrs. Roberts, Fothergill, & Co., of the Globe works, Manchester. The machine is used for perforating metal plates, such as are used for steam-boilers, &c., and was employed to punch the plates of the tubular bridge at Conway. Fig. 1, Plate LXVII., represents a sectional elevation of the machine; fig. 2, Plate LXVIII., an elevation of the back of the machine; fig. 3 a plan view of the apparatus for putting the punches out of action without stopping the fly-wheel, and fig. 4 a plan view of some of the Jacquard plates. Fig. 7 represents a front elevation, fig. 8 a side elevation, and fig. 9 a horizontal section, taken through the dotted line A' A' in figs. 7 and 8. Fig. 10 is a detached view of the traverse apparatus; fig. 11, a detached view of the holding-down or stripping apparatus. A, A, the standards; B, the bed, through which there is an opening for the punchings, or metal punched out of the plate, to fall through: this bed is inserted into the standards. C, a stretcher-bar, to connect the top of the standards; D, fulcrum of the levers *g*, *g*, which withdraw the punches, and of the lever *m*, which traverses the plate; E, a fulcrum-shaft to which the levers *ii* and *kk* are keyed; F, the main or eccentric shaft, working in bushes in the standards; G, a spur-wheel keyed on the eccentric shaft; H, a pinion working into the wheel G; I, the fly-wheel shaft, on which are the fast and loose pulleys K and L; the pinion H, and the fly-wheel J; M, M, connecting-rods fitted to the eccentric necks of the shaft F; N, N, caps of the connecting-rods M, M; O, O, guide-plates for [illegible] Q, the cam-shaft; R, a [illegible] shaft, and having on one [illegible] which there is an op[illegible] keyed on the shaft [illegible] which takes into the [illegible] on the wheel R; R and R" are [illegible] and 6a, the dotted lines on [illegible] counterbalance the levers k; [illegible] wheel keyed o[illegible] the main shaft F; [illegible] to the connecting-rods [illegible] lower end of the [illegible] which the frame [illegible] be punched. V, V, [illegible] to carry one side of the traverse-frame; [illegible] of iron, fastened with short [illegible] the die-plate X, into which the dies are inserted, and prevented from rising by a collar at the lower end of each, as seen in fig. 11; Y, a square shaft carrying the holding-down levers, or [illegible] levers on each end of the [illegible] let into the punch-holders [illegible] as seen in the detached view, [illegible] to the bed B, to carry the [illegible] D, dies inserted into the [illegible] selecting [illegible] without being push[illegible] roller has in this [illegible] [illegible] plates, after [illegible] passes over a [illegible]

at such an angle as shall keep the [illegible] tight whilst the roller *f* advances [illegible] from, the selectors *e*; *g*, *g*, brackets projecting from the depressor T, and carried up and down with it; *h*, *h*, sliding-blocks, in which the journals of the card-roller turn. To an upright cast on each of these blocks is fitted a rod of iron [illegible], with a flat foot long enough to extend over two of the six pins in the end of the card-roller, against which the flat foot of the rods is made to press by spiral springs coiled round them in the usual manner employed in the Jacquard loom (which see); the roller *f* is made to turn through one-sixth of a revolution, and is then retained in that position by the pressure of the spiral spring and flat foot above referred to; *l*, *l*, are brackets attached to the depressor T, at the back of the machine; *m*, a bar resting on the brackets *l*, *l*, and connected by rods with the sliding-blocks *h*, *h*, which, on receding, cause the bar *m* to bring all the selecting-bars (*e*) into the position for depressing the rams, as seen in fig. 11; *n*, *n* are levers having their fulcra on studs screwed into the standards; one end of these levers is connected by a rod (*p*) with the levers *s*, *s*; the other end is furnished with a roller, which is acted upon by a cam (*u*) on the shaft Q. *o*, *o* are the holding-down levers, adjustable laterally on the shaft Y, so as to admit of one of them being placed on each side of every punch. *p*, *p* are rod[illegible] the levers *n* and *s*. By adjusting the length of [illegible] levers *o*, *o* are made to [illegible] thicknesses, so as to [illegible] punches are being wi[illegible] *q*, *q*, levers turning on the fulcrum-bar D, for withdrawing the punches by means of the [illegible] that actuate levers *q*, *q*. [illegible] broad, but [illegible] thin bar, extending through the series of punch-rams P, shown by dotted lines. The punch-rams P are made with slots, through which the bar *s* passes, and these slots must be about two inches longer than the w[illegible]th of the bars, in order to allow the punch-rams to [illegible] forced down when the bar is at the bottom of [illegible] stroke. *t*, *t* are links connecting the bar *s* with the levers *q*, *q*. *u*, *u* are cams which depress the holding-down levers *o*, *o*, through the medium of the levers *n*, *n*, rods *p*, *p*, and levers *s*, *s*, and hold down the plate while the punches are being withdrawn *v*, a cam for the traversing-rack 5 *w*, a lever turning on the fulcrum-bar D, and worked by the cam *v*. [illegible] the cam for lifting the rack 5 *y*, a lever turning on a stud in the standard, and worked by the cam *x*, for lifting the traversing-rack 5. 3, a rod connecting the lever *y* with the lever [illegible] 1 is a lever on the transverse-shaft 2, 3 another lever on the shaft 2, 4, a link connecting the lever 3 with the rack 5; 6, a rod connecting the lever *w* with lever 1, for traversing the rack 5; 7, a shaft for carrying the levers 8, 9, and 10, 11, a link connecting the levers 10 and 12; 13, a shaft carrying the levers 12 and 14; 15 and 16 are links connecting the rack 5 with the levers 9 and 14; 17, the upper or retaining rack; 18, a stud carrying the elbow-lever 19, which is provided with a hand, 20, another stud, carrying the elbow-lever 21, which is connected by a link (22) with the lever 19. The rack 17 is carried on studs in the horizontal arm of the levers 19 and 21. 23, division-studs in the bar 24 of the traversing-frame. The plate to be punched is put into a traversing-frame formed of two side-bars, 24 and 25, and two stretcher-bars, [illegible] by collars to the side-bars, which [illegible] to support the plate, and, when required; furnished with clamps to hold the plate down. 24 represents one of the sides of the traversing-frame, in which there is a groove to fit on the slide-bar U into the outer side of the bar 24 is screwed a series of studs (23), represented in the engravings as being twelve inches from centre to centre apart from each other. The side (25) of the frame slides on the bars V, V. When the plates to be punched are very long, rollers may be used to carry the projecting ends of the traversing-frame. In fig. 9 is shown a part of a frame with a plate perforated. The racks 5 and 17, fig. 10, are drawn with three teeth in the length of a foot, which will divide plates to a four-inch pitch; but it will be obvious that for a different pitch, the racks must be changed, and it may in some cases (such as when the pitch required is not an aliquot part of a foot) be necessary to alter the distance between the

[illegible] Fig. 10 represents the [illegible] apparatus in the position it will be in when the [illegible] is down and the punches in the act of punching through the plate, and the traversing-rack having completed its return stroke. When the punches are being raised, the traversing-rack will rise also; and by the side-piece 26 (which is attached to it) acting against the roller 27, on a stud in the rack 17, will raise it also and set the frame at liberty to be advanced by the cam *v*, through the mechanical means already described. In fig. 1, this traverse apparatus is shown in the position it assumes when the plate is advancing. The spiral spring 28 acts on the lever 21, and forces the rack 17 down on to the pins 23. For every hole required to be punched in line with the width of the plate under operation, a corresponding hole must be made in a plate of the Jacquard; and an additional hole, marked 30, is also made, into which the stopping-bar 31 enters at every stroke until the punching be completed, at which time the Jacquard plate 32, which is left blank, will push all the selecting-bars (*e*) beyond the rams P, and, at the same time, by pushing the bar 31, disengage the cam-shaft Q by the mechanism to be hereafter explained, at the point where the levers and the punches *o* are held up, and thus will allow the perforated plates to be taken out of the machine and another plate to be put into it. The stopping-bar 31 is provided with a projection on its lower surface, which depresses the click-lever 39 when the bar is pushed back; the lever 32 is keyed on a shaft (34) moving in bearings at the back of the depressor; on the other end of the shaft 34 is keyed the lever 35, to the upper end of which is attached the link 36 connecting it with the elbow-lever 37; the end of the other arm of this lever is inclined, for the purpose of unlocking the plate R*, and is provided with a stud, on which is a latch (38), the tail of which comes in contact with the incline on the elbow-lever 37, when it is in the position shown in the dotted lines shown at fig. 3; and as the wheel R revolves, the latch becomes disengaged from the open[illegible] between the two projections cast on the said wheel, at which time the cam-shaft Q ceases to revolve. When the stopping-bar 31 has been pushed back, it depresses the lever 39, and liberates the lever 39 from behind the projection on the lever 32, when the spring 40 will pull the elbow-lever 37 into the position shown by the dotted lines. To the bl[illegible] *h* a small shaft is attached, on which are two levers, suspending by hooks a plate of metal similar to a blank card-plate, except that the holes for the guide-pins are cut at the bottom edge. At each end of the same shaft is a lever-handle, held up or down by a side spring in the ordinary way. The use of this apparatus is as follows.—Should it be required to stop the machine before the plate is finished, by raising the lever here referred to, the blank plate will come in front of the roller, and will act the part of a blank Jacquard plate, and stop the machine.—Having thus described the principal parts of the machine, we shall proceed to explain the manner of its working. The plate to be punched having been placed in the traversing-frame, on the sides U and V, is then pushed forward. In its progress the first pin of the series, 23, passes under the inclined end of the rack 17, until the first notch in the rack falls upon the pin. The driving-strap being now on the fast pulley [illegible], the machine is set to work by pulling down the handle [illegible], keyed on the shaft 34, until the lever 32 is latched by the click-lever 39; the elbow 37 is then, by the spiral spring 40, brought into the position shown in fig. [illegible] The latch 38 being now liberated, will, by the action of the spring 41, fig. 1, drop into the notch in the wheel R the first time it comes round; the cam-shaft Q will now revolve at the same speed as the shaft [illegible], and the Jacquard roller *f* will be drawn back and made to perform ⅙th of a revolution on its centres, after which it will be advanced and the first card-plate of the series will remove the selecting-bars for which there are no holes in the Jacquard plate; the other selecting-bars will remain over their respective [illegible] (P), which will then force down the punches through the plate by the descent of the depressor T. A little before the punches have gone through the plate [illegible] the levers *o* are made to press upon [illegible] hold there while the punches are being [illegible] the

bar *s*, which rises simultaneously with the depressor T during one half of its ascent. Whilst the depressor is continuing its ascent and descent through the other half of the stroke the roller *f* recedes, and draws with it the *bar m*, which brings all the selectors again over the punch-rams P. The roller *f* while receding, having performed another sixth of a revolution, will, on advancing, bring another of the Jacquard plates against the selectors, and the operation will be repeated until all the holes are punched in the plate under operation.

JADE is the common name loosely applied to several similar minerals, such as nephrite, serpentine, and axe-stone. Jade nephrite chiefly consists of silica, magnesia, and lime. Its closeness of structure and susceptibility of taking a high polish cause it to be used as an ornamental stone. It is tough, translucent,



THE JAGUAR (*Felis Onça* of Linnæus).

and of about the hardness of quartz. Its specific gravity is 3. In colour it is bluish, light green, or flesh-tinted. With some difficulty it is capable of being fused into a white enamel.

JAGGERY, [illegible] *-ger-re*, the name by which palm sugar is commonly [illegible] India. (*See* SAGUERUS.)

JAGUAR, *jăg'-wer* (*Felis Onça*, Linn.), the American panther, the form of the leopard found in the New World. The form of the jaguar is robust, stouter than the leopard, and strongly and almost clumsily built. The body is thicker, the limbs shorter and fuller, and the tail barely reaches the earth when the animal stands well upon its feet. The head is larger and somewhat shorter than that of the leopard, and the profile of the forehead is more prominent. The animal is said to measure from four to five feet from the nose to the root of the tail when full grown. On the whole of the upper part of the body it is of a bright yellowish fawn-colour, which passes, on the throat, belly, and inside of the legs, to a pure white. Upon this ground, the head, limbs, and under-surface are covered with full black spots of different sizes; the rest of the body is covered with annular patches, either having a black point in the centre, or formed of small black spots arranged in a circular form. The jaguar is a native of South America,—Paraguay and the Brazils principally; but it is said to have been met with in all parts between the Isthmus of Darien and the southern extremity. Anatomically, the jaguar presents an immense volume of chest when contrasted with the abdominal cavity,—a circumstance which furnishes an index to the habits and vital energy of these active and ferocious animals. That the jaguar is easily frightened is proved by the following account by Humboldt:—"Two Indian children (a girl and a boy), the one about seven, the other about nine years old, were at play on the outskirts of a village, when, about two o'clock in the afternoon, a large jaguar came out of the woods and made towards them, playfully bounding along, his head down and his back arched, in the manner of a cat. He approached the boy in this way, and began to play with him; nor was the latter even sensible of his danger until the jaguar struck him so hard on the head with his paw as to draw blood, whereupon the girl struck him with a small switch she had in her hand; and he was already bounding back again, not at all irritated, to his retreat, when the Indians of the village, alarmed by her cries, came up to them." A number of very interesting anecdotes relating to this animal are to be found in the "Journal of a Passage from the Pacific to the Atlantic," by Lieut. Maw, R.N. The following circumstance, narrated by D'Azara, gives a notion of its power of swimming, as well as of its enormous strength:—A jaguar, after having attacked and destroyed a horse, carried the body of his victim to the bank of a broad and rapid river about sixty paces distant, over which he swam with his prey, and then dragged it into the neighbouring wood. This was all witnessed by the man whom D'Azara had placed in concealment in order to watch. The jaguar is a most adroit climber, and Sonnini states that he

saw the scratches left by the claws of one on the smooth bark of a tree nearly forty feet high, without branches. Baron Humboldt also heard the yell of the jaguar from the tops of the trees, followed by the shrill whistle of the terrified monkeys. Possessed of such tremendous powers, the jaguar becomes the terror of the inhabitants of the countries which he infests. None of the living quadrumana or quadrupeds seem to come amiss to its voracious appetite, and it devours with relish birds, fish, and even reptiles. The shells of turtles which had been emptied by jaguars were pointed out to Humboldt. Notwithstanding all this ferocity, the jaguar seldom attacks the human race, though he will not shun man when he meets him. Indeed, according to Sonnini and Humboldt, he will often follow travellers. His favourite prey seems to be the larger quadrupeds; such as oxen, horses, sheep, and dogs, which he attacks indiscriminately, and in the same treacherous manner as the rest of the *Felidæ*. When he has made choice of a prey, he springs on its back, and placing one of his paws upon the back of the head, whilst he seizes the muzzle with the other, twists the head round with a sudden jerk, dislocating the spine, and thus killing his victim at once. The inhabitants of South America hunt the jaguar in various ways, either with a pack of dogs or by means of the lasso: the latter mode, however, can only be adopted upon plains or open grounds. Notwithstanding the strength and ferocity of the jaguar, he finds a powerful opponent in the great ant-eater. Although the latter animal has no teeth, whenever he is attacked by the jaguar, he lies on his back, and suffocates or strangles his opponent with his long claws. There is a black variety of the jaguar,—*le jaguar noir* of the French, and probably the jaguarete of Marcgrave.

JAIL. (*See* PRISONS.)

JAINS *or* JAINAS, *jains, jai'-nās* (Sans. *jina*, victorious), is the name of a religious sect among the Hindoos. They are very numerous in the southern and western provinces of Hindostan, and are principally engaged in commerce. It is believed that Jainism is of much later origin than Buddhism or Brahamism, and that it did not rise into importance till the 8th or 9th century of our era. It seems to partake of both of these earlier worships, and was probably an attempt to reconcile Buddhism with Brahamism. The principal points of difference between them and the [illegible] are,—1. a denial of the divine origin of the Vedas, 2. the worship of certain holy mortals, who, by living exemplary lives here and by self-mortification, had raised themselves superior to the gods, and, 3. extreme tenderness for animal life; in all of which points they resemble the Buddhists Their moral code, or "great duties," are,—1. refraining from injury to life; 2. truth; 3. honesty; 4. chastity; 5. freedom from worldly desires. Their four "merits" are—liberality, gentleness, piety, and penance. For further information, see *English Cyclopædia*—Arts and Sciences, and the numerous works therein referred to.

JALAP, *jal'-lăp* (from Chalapa or Xalapa, its native place). (*See* IPOMŒA.)

JALAPIN, *jăl'-ă-pin*, in Chem., a resin insoluble in ether, found in jalap, and supposed to constitute the purgative principle of that substance. It is also called *convolvulin* and *rhodeoretin*.

JAMBS, *jămbz* (Fr. *jambes*), in Arch., the sides of an aperture which connect the two sides of the wall. The two vertical linings of a doorway or aperture, which connect two walls, are called the *jamb-linings*. Jamb-posts are such as are introduced sometimes on the side of a door, in order to fix the jamb-linings. They are particularly used when the partition is of wood.

JAMES, EPISTLE OF, *jaims*, is the name of one of the canonical books of the New Testament. The authorship of this book has been disputed. There are three persons of this name mentioned in Scripture: 1. James the Apostle, son of Zebedee, and brother of John; 2. James the Less, son of Alpheus and Mary, who was also an apostle; and, 3. James, the brother of our Lord. It is generally held by divines that it

meaning those that had embraced Christianity. The design of the apostle in writing this epistle was,—1. to prevent the Jewish Christians from falling into the vices which abounded among their countrymen, and to caution them against covetousness and sensuality, distrusting the divine goodness, &c.; 2. to set them right as to the doctrine of justification by faith; 3. to intimate to such as laboured under bodily disorders, that, if they were penitent, they might hope for a miraculous cure; and, 4. to prevent their being impatient under their present persecutions or dark prospects, and to support and comfort them by the assurance that the coming of the Lord was at hand. The language of this epistle surpasses all the other writings of the New Testament in the purity of its Greek, in liveliness, and in felicity of expression. No regular plan appears in it, and the ideas sometimes follow one another loosely, the writer passing from one subject to another without points of transition · but it contains an abundance of fine striking images, which, considered together, have no parallel in any other apostolic letter. The canonical authority of this epistle has been much disputed both in early and more recent times. It is classed by Eusebius among the *antilegomenai*, or writings whose authenticity was questioned, and it was rejected by Luther and some of the other reformers. The great argument in its favour is its being found in the Syriac version of the New Testament executed at the end of the 1st or early in the 2nd century.

JAMES'S POWDER, a compound of phosphate of lime and antimony.

JANIPHA. (*See* MANIHOT.)

JANISSARIES, *jan'-e-za-reez*.—A body of Turkish infantry, now extinct. The name is derived from *yenitcheri*, or *yeni*, and *askeri* (new troops). According to a Turkish historian, they were first assembled in 1329 by Sultan Orchan; but they were not regularly organized until 1362, when Amurath I., after conquering the southern Slavic kingdoms, claimed one-fifth of the captives, including the able-bodied youth, to be converted to Islamism and educated as soldiers. This was done with extraordinary care, the recruits being distributed first among the peasantry of Asia Minor, that they might become hardened by rural life and familiar with Mahommedanism. The result was, that they manifested all the enthusiasm of proselytes. Privileges being granted them, they soon became a formidable means of defence. They were divided into 198 *ortas*, each numbering—in Constantinople nominally 100 men, and elsewhere 200 and 300 in time of peace, and 500 in time of war. They were under the command of an *aga*, or commander-in-chief. At first this fine soldiery rendered signal services to the Turkish empire; but at length the recruits were taken from all ranks and classes, but principally the lowest. A spirit of insubordination became their chief characteristic. In 1808 Mahmoud formed the plan of getting rid of these troops. He gathered them together by a stratagem, and burned them alive in their barracks, or cannonaded them at the Meidan. Those who survived were sentenced to exile. About 25,000 janissaries were thus killed, and since that time they have never been reorganized.

JANSENISTS, *jăn'-sen-ists*, a party in the Roman Catholic church, which arose about the middle of the 17th century, and took its name from Cornelius Jansenius, bishop of Ypres, who died in 1638. He was a great advocate for the doctrines of Augustine, some of whose works he is said to have read thirty times, and left a work, which was published after his death, under the name of *Augustinus*, in which, supported by quotations from the works of Augustine, he set forth the doctrine of irresistible grace and absolute election and rejection. This doctrine was not new, for it had already several times agitated the Church. Michael Bains, professor at Louvain, had already asserted this doctrine, and seventy-six propositions, taken from his writings, were condemned by a papal bull in 1567. Jansenius's work was fiercely attacked by the Jesuits as heretical, and as containing the five following propositions:—1. That there are certain commandments of

in the fallen state of nature can resist the influence

of divine grace; 3. to render themselves meritorious in the sight of God, it is not requisite that men should be exempt from internal necessity, but only from outward constraint; 4. that the semi-Pelagians are heretical in maintaining that the human will is able to resist or obey the influences of divine grace; 5. that to say that Christ died for all men, is semi-Pelagianism. After much intriguing and delay, the five propositions were condemned by Pope Innocent X. as heretical but this by no means ended the dispute, for the Jansenists contended that they were condemned in a sense different from that which they were intended to bear by the author. An appeal was again made to the p---, and in 1656 a new bull was issued by Alexander VII, declaring that Jansenius meant the propositions in the sense condemned by the previous bull. A formulary was now drawn out, conformably to the new bull, and all ecclesiastical persons were required to sign it, on pain of being suspended from their offices. Most of them refused, and a schism was thus occasioned in the French church, which lasted for some time. The Port Royalists (*see* PORT ROYAL), Arnauld, Pascal, Nicole, Perrault, were conspicuous for their defence of Jansenism, and, not content with acting on the defensive, carried the war into the enemy's country, attacking the errors and corruptions of the Romish church, especially of the Jesuits; one of the ablest of their attacks being the "Provincial Letters" of Pascal. They also, as a means of dissipating error, encouraged the diffusion of education, and published a number of valuable educational works. At length, Clement IX., in order to bring about peace, attempted to compromise matters, by asking merely a rejection of the five propositions, without ascribing them to Jansenius. The liberal policy of Innocent XI. tended still more to restore peace. In 1693, however, the smouldering fire was again stirred up into a fierce flame by the appearance of Father Quesnel's "Moral Observations on the New Testament." Quesnel was banished from the country; and in 1709, Louis XIV., at the instigation of his Jesuit confessor, suppressed and destroyed the monastery of the Port Royal, and the most revolting indignities were offered to the ashes of its illustrious dead. In 1713, Clement XI. issued his famous bull *Unigenitus*, condemning 101 propositions of Quesnel's work. The strife continued for some time after this, and many of the Jansenists emigrated to Holland. A number of the French clergy still hold the principles of Jansenius, and since 1864, they have had an organ in the religious press, *L'Observateur Catholique*. While Jansenism remained in France a theological school, it became in the Netherlands an independent church. In 1704, Codde, the vicar-apostolic of the archbishopric of Utrecht, was deposed by the pope for holding Jansenistic views; but the chapter refused to acknowledge the validity of this deposition, and in 1723 they chose an archbishop of their own. Since that time they have had an archbishop at Utrecht, and bishops at Haarlem and Deventer. These Jansenists call themselves by preference the disciples of St. Augustine, whose doctrines they maintain, upholding moral strictness, and regarding the inward service of God as the greatest proof of piety. The Jansenistic principles also extended to Italy, especially to Tuscany, where Bishop Ricci and his party effected a temporary schism.—*Ref.* Tregelles, *The Jansenists*, Lond. 1851; *History of the so-called Jansenist Church in Holland*, by Rev J. M. Neale, Oxford, 1858.

JANUARY, *jăn'-u-ā-re*, the name of the first month of our year, so called from the god Janus, who is commonly represented with two faces, as it was considered both to look back upon the past year and forward to that which was coming. It was likewise the first month in the Roman calendar, to which it was added, together with February, by Numa. It was not uniformly, however, the first month of the year among the Latin Christian nations until the 16th century; and even in some parts of this country the year commenced with the month of March till 1751, when an act was passed adopting the Gregorian in place of the Julian style, and declaring that the legal year shall be uniformly deemed to begin on the 1st of January.

JAPAN LACQUER, *jăp-ăn'*, a valuable hard black varnish, much used by the cabinet-makers of the Eastern Archipelago. It consists of the gummy juice which exudes from the *Stagmaria verniciflua*, a tree belonging to the nat. ord. *Anacardiaceæ*.

JAPANESE ALLOYS.—Very recently many beautiful articles in metal have been brought to this country from Japan. The objects are generally made from some alloy, respecting the composition of which nothing was known, until an American gentleman, Mr. Raphael Pumpelly, communicated a series of interesting notes respecting the composition of many Japanese alloys, from information which he had obtained in Japan from native metal-workers. 1. *Shakdo* is an interesting alloy of copper and gold, the latter metal in proportions varying between one per cent. and ten per cent. Objects made from this composition, after being polished, are boiled in a solution of sulphate of copper, alum, and verdigris, by which they receive a beautiful bluish-black colour. This colour can only be explained by supposing that the superficial removal of the copper exposes a thin film of gold, and that the blue colour produced is, in some manner, due to the action of light on this film of gold. The intensity of the colour, and to a certain extent itself, are proportionate to the amount of gold, one or two per cent. of this metal producing only a rich brown colour. Pure copper treated in the above solution received the appearance of an enamelled surface with a rich reddish tint, and brass a similar surface with a darker shade. Shakdo is used for a great variety of ornaments; as sword-guards, pipes, clasps, &c. 2. *Gin shi bu ichi* ("quarter silver") is an alloy of copper and silver, in which the amount of silver varies between 30 and 50 per cent. Ornamental objects made from this composition take, when subjected to the action of the above solution, a rich grey colour, much liked by the Japanese. It is used for sword ornaments, pip— and a great variety of objects. 3. *Mokume.*—F— alloys and metals of different colours associated in such a manner as to produce an ornamental effect. Beautiful damask-work is produced by soldering together one over the other, in alternate order, thirty or forty sheets of gold *shakdo*, silver, rose copper, *gin she bu ichi*, and then cutting deep into the thick plate thus formed with conical reamers, to produce concentric circles, and making troughs of triangular section, to produce parallel, straight, or contorted lines. The plate is then hammered out till the holes disappear, manufactured into the desired shape, scoured with ashes, polished, and boiled in the solution already mentioned. The boiling brings out the colours of the *shakdo*, *gin shi bu ichi*, and rose copper. 4. *Brasses* (*Sin chu*).—The finest quality of brass is formed of ten parts of copper and five of zinc. A lower quality is compounded of ten parts of copper and 2·7 of zinc. 5. *Kava kene* (bell-metal).—The first quality of this alloy is compounded of ten parts of copper, four of tin, half-part of iron, and one and a half-part of zinc, the second quality is formed of ten parts of copper, two and a half parts of tin, one and a third part of lead, and half a part of zinc, the third quality is formed of ten parts of copper, three parts of tin, two parts of lead, half a part of iron, and one part of zinc. There is a fourth quality, containing ten parts of copper, two parts of tin, and two parts of lead. In forming the bell-metals, the copper is first melted, and the other metals added in the order given above. The best small bells are made from the first quality. The *kava kene* has a wide range of use in Japan. *Solders.*—For bell-metal: brass 20, copper 10, tin 15 parts. For brass, first quality: brass 10, copper 1½, zinc 6 parts. For silver: silver 10, first-quality brass 5 or 3. For *gin shi bu ichi*: silver 10, first-quality brass 5, zinc 3. For *mokume*: silver 10, first-quality brass 1½ part. For *shakdo*: fine shakdo 3, zinc 10 parts. For tin: tin 10, lead 5 parts. Among the Japanese articles made of copper that find their way to this country, there are some with a bright red surface, which is often taken to be either a lacquer or an enamel. These objects are made of copper containing red oxide through the entire mass, and after receiving the requisite form and a high polish, are boiled in the mixture mentioned above.

JAPAN SAGO. (*See* CYCADACEÆ.)

JAPANESE PEPPER. (*See* XANTHOXYLON.)

JAPANESE WAX. (*See* RHUS.)

JAPANNING, *jăp-ăn'-ning*, the method of giving a

hard and highly-polished surface to articles made of wood, metal, paper, or leather. It is applied to tea-trays and bread-baskets of iron or papier-mâché (*see* PAPIER-MÂCHÉ), boxes and tea-caddies made of wood, candlesticks, snuffers, and a great variety of articles of every-day use. Japanning, when applied to common tea-trays of sheet-iron, saucepans, grates, and other articles of hardware, merely consists in covering the surface of the metal with a hard and lustrous black varnish. In iron bedsteads of a common kind, the metal frame and laths are merely painted with colouring matter mixed with a clear transparent varnish. When applied to wooden bedsteads, wash-stands, chairs, &c., it consists in coating the same with colouring matter that has been mixed with turpentine instead of oil. In the better kinds of japanned-work there are four separate stages,—priming, putting on the ground, putting on the pattern in gold or colours, and finishing. The first stage consists in covering the article to be japanned, if it be made of wood, with a composition of size and whiting, to produce evenness and smoothness of surface; but this is said to be detrimental to the durability of the coats of varnish that are laid on it, from its brittle nature, so it is seldom applied unless the wood be soft and porous. For articles made of hard close-grained wood and metal, a simple coat of varnish is the only priming required. When this preliminary coat is quite dry, the ground is put on, which consists of various kinds of colouring matter of an earthy nature, mixed with copal varnish, or varnish made of seed-lac or gum-animi. One or two coats of this mixture are applied, after which the work receives three or four coats of varnish, and is dried in a stove. If a ground of gold, silver, or bronze be desired, the work is coated with japanner's gold size, over which metallic dust is spread to produce the required appearance. When the ground is dry, the pattern is produced upon it by painting it in colours prepared in the same manner, or by gilding with gold size and gold dust, if the whole, or any part of the pattern, is to be produced in gold. Sometimes engravings that have been printed on paper prepared for the purpose, with a coating of gum or isinglass, are transferred to the surface of the work, the print being laid face downwards on the ground, and the paper removed by moistening the back with warm water, which dissolves the gelatinous matter on which the impression has been taken. The final stage is that of finishing, which consists in covering the whole work with several successive coats of varnish, each being allowed to become quite dry before the next is applied. When the last coat is thoroughly dry and hard, the surface is polished first with rotten-stone, and afterwards with a little oil. The art derives its name from the island of Japan, where a hard exterior and extremely brilliant polish is put on articles chiefly made of wood, by means of a natural varnish procured from a tree that is indigenous to the east of Asia. The term lacquering is sometimes applied to this art. The process of manufacturing japanned leather is most successfully followed by the French. They furnish the best of the highly-glazed brilliant material called in trade patent leather. A great deal of the superiority of the French leather is due to the quality of the calf-skins they employ. They select the lightest and softest skins. The Americans have made great efforts to emulate the French in the production of japanned leather, and a very large manufactory has been established at Newark, New Jersey. The leather used at Newark is curried expressly for the purpose, and particular care is taken to keep it as free as possible from grease. The skins are then tacked on to frames, and coated first with a composition of linseed oil and umber, in the proportion of 18 gallons of the former to 5 ounces of the latter, boiled till nearly solid, and then mixed with raw oil and spirits of turpentine to the proper consistency; lamp-black is also added when the composition is applied, in order to give colour and body. From three to four coats of this are necessary to form a surface to receive the varnish, the coats being laid on with a sort of knife or scraper. To render the material soft and pliant, each coat must be very light, and thoroughly dried between each application. A thin coat is afterwards applied of the same composition, of a consistence to be put on with a brush, and with sufficient lamp-black boiled in it to make it a perfect black. When thoroughly dry, it is cut down with a scraper having a turned edge, whereupon it is ready to varnish. The principal varnish used is made from linseed oil and Prussian blue, boiled to the thickness of printer's ink. It is reduced with spirits of turpentine to a consistence suitable to work with a brush, and is then applied in two or three separate coats, which are scraped and pumice-stoned until the leather is perfectly filled and smooth. The finishing coat is put on with especial care in a room kept closed and with a wet floor, to prevent dust. The frames are then run into ovens heated to 175° Fahr. In preparing this kind of leather, the manufacturer must give the skins as high a heat as they can bear, in order to dry the composition upon the surface as rapidly as possible without absorption, and at the same time cautiously, so as not to injure the fibre of the leather. Japanned leather includes both the varieties called "patent leather" and "enamelled leather," the difference between the two consisting in this, that the former is finished full and smooth, while the latter is finished with as little composition as possible, and the grain of the enamelled variety is formed by rolling with the graining-board. Instead of using ivory or lamp-black as an ingredient in the varnish, various pigments may be introduced to give any desired colours to the leather,—as, for blue, ultramarine or Prussian blue mixed with a little white; the red lakes for a red colour: the ochres for their peculiar colours, and white lead for white. In the Birmingham and Wolverhampton districts a large trade is done in the ja[illegible] sheet-iron trays and other articles.

JAR, ELECTRICAL, OR LEYDEN JAR, *jar* (Sp. *jarr[illegible]*, a jar), a jar or phial used in electrical experiments. It is an example of a solid dialectric between two conducting substances. By means of this instrument the electric fluid can be accumulated and preserved in large quantities. The author of this great invention is not distinctly known; the merit appears to be claimed for three persons independently,—a monk of the name of Kleist, a person of the name of Cuneus; and Professor Muschenbrock, of Leyden; all of whom lived about 1745. The invention, however, was called the *Leyden jar*, because it was either invented or applied principally in that city. Muschenbrock had observed that excited electrics soon lost their electricity in the open air, and that their loss was accelerated when the atmosphere was charged with moisture or some other conducting material; he therefore conceived the idea that the electricity of bodies might be retained by surrounding them with bodies which were not conductors. In order to test this idea by experiment, some water was electrified in a glass bottle; an assistant held the bottle, and, whil[illegible] to disengage the communicating wire, he receiv[illegible] sudden shock in the arms and breast. This is said to have been the origin of the Leyden jar. Its present form is that of a glass bottle, coated within and without with tin-foil,—the upper part of the jar being left uncovered, in order to insulate the two coatings. A wire, surmounted by a brass knob and terminating in a brass chain, passes through a wooden lid. When the knob of the jar is presented to the conductor of the machine in action, a succession of bright sparks passes from the conductor to the knob. Conducted by the wire and brass chain, the electricity spreads itself, by means of the coating of tin-foil, over the interior of the glass, the particles of which become polarized, decomposing the electricity of the outside of the jar, and leaving it in an opposite state. At the same time, the electricity of the same name must pass from the outer coating to the earth, in order to act, it is therefore necessary that the jar be uninsulated. If a jar be insulated, it is only capable of bearing a feeble charge; but if a conductor be held near the outer coating, sparks will pass from the outer coating to the conductor for every spark that passes from the prime conductor to the knob of the jar. In this way a large number of jars may be charged, in which every one is insulated except the last. Electric equilibrium, after disturbance, may be restored either by conduction, disruption, or convection. When a charged jar is discharged by means of a discharging-rod (which *see*), the electricity is conducted quietly through the wire of the discharger as

long as contact is maintained; but when it is made to traverse the air between the knob of the jar, a brilliant spark passes, accompanied by a characteristic crackling sound. When the outside foil is touched with one hand, while the knob or chain communicating with the inside of a charged jar is touched with the other, a bright spark and a powerful shock are produced. The glass of the Leyden jar should be thin. Cavendish ascertained that the quantity of electricity produced in the Leyden jar, with given surfaces, was inversely proportional to the breadth of the glass.

Jarl. (*See* Earl.)

Jasher, Book of (Heb., book of the upright), is the name of a book referred to in two passages of the Old Testament (Josh. x. 13; 2 Sam. i. 18), but now lost. Some have held that it was the book of Deuteronomy, others Judges; others the books of Samuel themselves. St. Jerome and some others were of opinion that it was the book of Genesis. Bishop Lowth, from the poetical nature of the citations from it, considered that it was a collection of national songs; in which opinion he was followed by Gesenius, who thought that it acquired its name, the "book of the upright," from being written in praise of upright men. The general opinion is that the book of Jasher is one of those writings which perished during the captivity. Dr. W. J. Donaldson published in 1854 a book entitled "Jasher; Fragmenta archetypa Carminum Hebraicorum in Masorethico Veteris Testamenti textu passim tessellata," in which he attempts to restore this ancient record in accordance with his own idea of its scope and contents. He asserts that it was written during the reign of Solomon, probably by Nathan the prophet, assisted perhaps by Gad the seer; and that its object was to show that at first man was upright, but, by following carnal wisdom, had fallen away, while the Israelites were chosen to preserve and transmit this law of uprightness. He believes that it comprised the marrow of what is contained in the sacred scriptures, which were not then written; and that it was subsequently worked up in a careless or arbitrary manner into the books as they now stand, at least as far as the book of Psalms. With this view, he proceeds to build up his imaginary book of Jasher. Whatever in the sacred books exhibits the nature of uprightness, celebrates the victories of the true Israelites, [illegible] their prosperity, or promises future blessedness, was taken from the book of Jasher. Among the strange results of his arrangement, is that Shem, Ham, and Japhet are sons of Adam, not of Noah, who is Israel under a figure; Cain and Abel are sons of Shem, and Abraham is the son of Abel. There are also two rabbinical works that bear the title of the "Book of Jasher,"—one a moral treatise, written in the end of the 14th century by R. Shabbatai Carmuz Levita,—a copy of which, in MS., is in the Vatican library; the other, a treatise on Jewish laws, by R. Tham, written in the 13th century, and printed at Cracow in 1617. Another mediæval work, in Hebrew (printed at Venice and Prague in 1625), bears the same title, and is said to have been discovered at the destruction of Jerusalem by Titus, and to have been brought to Spain and preserved at Seville. It is probably the work of a Spanish Jew of the 13th century, containing the historical narratives of the Pentateuch, Joshua, and Judges, with many fabulous additions. A clumsy forgery was perpetrated in 1751, by one Jacob Ilive, a typefounder in Bristol, who published a work entitled the "Book of Jasher, with Testimonies and Notes explanatory of the Text; to which is prefixed various readings; translated into English by Alcuin of Britain, who went a pilgrimage into the Holy Land." This clumsy fraud was revived at Bristol, 1827; at London, 1833, edited by C. R. Bond; and at New York, 1840, edited by M. M. Noah.—*Ref.* Smith's *Dictionary of the Bible*.

Jasminaceæ, *jăs-min-ai'-se-e* (Arab. *jasmen*, jasmine), in Bot., the Jasmine fam., a nat. ord. of *Dicotyledones*, in the sub-class *Corolliforæ*. Shrubs often twining, with the following characters:—Calyx persistent, having 5—8 divisions; corolla regular, 5—8-partite, with imbricated æstivation; stamens 2, included; ovary 2-lobed, 2 celled, with 1—4 erect ovules in each cell; fruit a capsule or a berry; seeds with very little or no albumen; embryo erect. The *Jasminaceæ* are chiefly natives of the East Indies; but a few species are found in other warm regions of the globe. The flowers are generally fragrant. The *volatile oil of jasmine* used in perfumery is chiefly obtained by distillation from the flowers of *Jasminum officinale* and *grandiflorum*. The leaves of some species are very bitter, and have been employed medicinally. The flowers of the species *Nyctanthes arbor-tristis* are used in India for dyeing yellow.

Jasper, *jăs'-per* (Gr. *iaspis*), a mineral of the quartz fam., which occurs in the form of rocky masses, often making up large portions of hills of considerable size. In hue, it is of various shades of red, yellow, brown, and green, sometimes arranged in stripes, when it is called ribbon jasper. Its varied colours are generally derived from iron in different degrees of oxidation. Jasper is much used for ornamental purposes, on account of its hardness and susceptibility of taking a high polish. Bloodstone, or heliotrope, is a deep-green variety of jasper, with blood-red spots. Touchstone is a velvet-black flinty variety, used for testing the purity of gold alloys. The alloy is rubbed on the stone, so as to leave a metallic streak, and the quality is estimated by the brightness of the colour when nitric acid is washed over it. The principal deposit of jasper is the gorge of the Korgon, in Siberia. The labour of cutting out the blocks of jasper at this place is enormous: the workmen drill holes five inches apart, the whole length of the block, to the depth required; into these they drive dry birch-wood pegs, which are kept wet till they expand and burst off the mass. At the Crystal Palace of 1851, several cases of this jasper were exhibited, and a medal was awarded to them.

Jatrorhiza, *jăt-r-o-ri'-za*, in Bot., a gen. of the nat. ord. *Menispermaceæ*. The root of the species *J. palmata*, sometimes named *Cocculus palmatus*, forms the calumba of the Materia Medica. Calumba is extensively used as a tonic: its properties are evidently due to a crystalline alkaloid, called calumbine.

Jatropha, *jăt'-ro-fă* (Gr. *iatros*, physician; *trophe*, food, in allusion to the medicinal properties of the plants), in Bot., a gen. of plants belonging to the nat. ord. *Euphorbiaceæ*. The seeds of *J. purgans* and those of *J. multifida* are called physic-nuts. They yield by pressure fixed oils, and both the oils and seeds are [illegible] cathartic. The oil of *J. purgans* is commonly known as *oil of wild castor-seeds*, or *Jatropha oil*, and is well adapted for burning. It is sometimes employed to adulterate East-Indian croton oil. The seeds of *J. gossypifolia*, called bastard French physic-nuts, also possess purgative properties. The cassava, formerly included in this genus, is now placed in the genus *Manihot* (which *see*).

Jaundice, *jawn'-dis* (Fr. *jaunisse*, from *jaune*, yellow), in Med., is the name of a disease characterized by yellowness of the skin and eyes, the urine being saffron-coloured and the fæces usually whitish or drab-coloured. It is usually preceded by symptoms of a disordered state of the liver and digestive organs, as loss of appetite, irregular bowels or constipation, colic pains, nausea, headache, languor, &c. Sooner or later, the yellow colour begins to appear, usually first in the eye, then the face, and then the whole body. Sometimes the yellowness is the first symptom. From the time of the appearance of the yellow hue, many of the preliminary symptoms may diminish. The shades of yellowness are various, from a light yellow to a deep orange hue, and in some cases greenish, or even almost black, when it is known as green or black jaundice. Jaundice arises from the excretion of bile being prevented and retained in the blood, or re-absorbed and diffused throughout the system. It depends upon various and different internal causes. Any kind of pressure upon the excretory ducts will occasion it, as by tumours, &c.; by the ducts being plugged up by mucus, inspissated bile, or biliary calculus. Fits of anger, fear, alarm, &c., have sometimes been directly followed by jaundice. It may also occur as a symptom of acute or chronic inflammation of the liver. A high atmospheric temperature long continued has also a decided influence in producing certain forms of this disease. In general, we may expect a favourable termination of this disease, except when it depends upon structural disease of the liver, or supervenes suddenly upon some great mental or bodily shock. The greenish

or darkish varieties are the most dangerous. The course and duration of this disease is various, in some cases disappearing or proving fatal as early as the fourth day; in others continuing for months or years. Some kinds of jaundice are absolutely irremediable, others will pass away without any treatment. In general, the obvious treatment is to promote the secretion of the bile and to favour its removal. In general, mercury forms an essential part in its treatment, together with active purgatives. If there be any spasmodic pain in the right side, opium and the warm bath should be used; a mild diet, and the avoidance of all stimulants, to be strictly enjoined.

JAY, *jai* (Fr. *geai*, Sp. *gayo*), a bird belonging to the fam. of the *Corvidæ*, ord. *Insessores*, and termed by Bewick the *Corvus glandarius*. Its generic characters may be thus summed up —Beak shorter than the head, conical, slightly compressed, straight at the base, with the upper mandible distinctly notched and suddenly bent over the lower; nostrils basal, lateral, and hidden from view by superincumbent bristles; wings of moderate size and rounded, with the first three quill-feathers pectinated, while the fourth, fifth, and sixth are of nearly equal length, and the longest in the wing; legs of moderate size; tarsus longer than the middle toe, the outer toe being joined to the middle at its base, and rather longer than the inner one; claws stout, curved, and sharp; tail slightly rounded. The jay is a very handsome bird, well known in most of the well-wooded districts of England. It has been called by the appellation *glandarius* on account of its partiality for feeding on vegetable productions, such as acorns, berries, beech-mast, and other similar substances. The jay is generally about thirteen inches in length, and its general colour is a light purplish buff, which is paler in the under parts. Yarrell observes of this bird, in his "British Birds," "I have heard the jay perform an uninterrupted song; it mocked the greenfinch most inimitably, and it was a considerable time before I could persuade myself that it was an imitation. But what amused me most of all was its imitation of the neighing of a horse; this was so near the truth that some companions who were with me were a long time before they could be convinced that the sounds proceeded from the bird The neighing was very subdued and suppressed, but it bore the most striking resemblance to the neighing of a colt at a distance; indeed, so close was the imitation, that, without a sight of the bird, no person could possibly, I think, be persuaded that the sound proceeded from such an agent. These imitations were accompanied, occasionally, with more subdued and very melodious notes" Besides being common in England, the jay is also found scattered over most parts of Europe, and in America there is also a variety termed the blue jay (*Garrulus cristatus*), which is very common in the northern portions of that continent.

JEHOVAH, *je-hō'-va*, is a name given in Scripture to the Supreme Being. Its true pronunciation has been lost, as the Jews scrupulously avoid making any mention of it; and, according to their tradition, it was pronounced but once a year, by the high priest on the day of atonement, when he entered the holy of holies.

JELLY, *jel'-le* (Sp. *jalea*, from Lat. *gelo*, I congeal), a term applied to every translucent juice which, when cold, thickens, so as to coagulate into a trembling mass; thus the juices of acid or mucilaginous fruits, currants, &c., are called jellies when, by the addition of one part of sugar to two parts of juice, and by boiling, they have obtained a proper consistence. The term is also applied to a concentrated decoction of Iceland moss, rendered agreeable to the taste by the addition of sugar, &c. When the horns, bones, or extremities of animals are boiled to such a degree as to be stiff and firm [illegible]

[illegible] *vice* arising from alkalescent juices: in their nature they are cooling, saponaceous, and acescent. Jellies made from animal substances, on the contrary, are alkalescent, and are therefore good in all cases in which acidity of the humours prevails. Animal jelly is soluble in water, glutinous, becomes fluid by heat, coagulates in the cold, and combines with oil and resins.

JELLY-FISH, in Nat. Hist., a general term applied to the Medusa, or that division of the class *Acephala* called *Discophora* or *Pulmograda*. All the animals belonging to it are entirely gelatinous, consisting of a large hemispherical disc, more or less convex above, and closely resembling a mushroom or umbrella in shape. (*See* MEDUSA.)

JEMIDAR, *jem'-e-dar*, a native officer in the East-Indian army, who holds a rank somewhat similar to that of a lieutenant in the regular service.

JENNY. (*See* SPINNING.)

JEREMIAH, *jer-e-mi'-ah*, the name of one of the prophetic books of the Old Testament, called after its author, the prophet Jeremiah. It embraces a period of upwards of forty years, between B.C. 629 and 586. The various prophecies of this book are arranged without any regard to the order of time in which they were delivered. The following arrangement will serve to make the book more intelligible to the reader:—1. The prophecies delivered in the reign of Josiah (i.—xii.); 2. in the reign of Jehoiakim (xiii.—xx., xxii., xxiii., xxxv., xxxvi., xlv.—xlviii., and xlix. 1—33); 3. in the reign of Zedekiah (xxi., xxiv., xxvii.—xxxiv., xxxvii.—xxxix., xlix. 34—39, l., li.); 4. under the government of Gedaliah, from the taking of Jerusalem to the retreat of the people into Egypt, and the prophecies of Jeremiah delivered to the Jews in that country (xl.—xliv.). The last chapter (lii.) was added by some other hand, probably Ezra, subsequently to the return from the captivity, of which it gives a short account, and forms a proper argument or introduction to the book of Lamentations by the same author, which immediately follows. Some have professed to see in the style of Jeremiah marks of rusticity; but though wanting the dignity and splendour of Isaiah, it is by no means destitute of elegance or sublimity. His prevailing tone is that of melancholy, and his mind is so deeply and sorrowfully impressed with certain scenes and events, that he dwells upon them with all the tenacity of overwhelming anguish. "Though his sentiments are not always the most elevated, nor his periods uniformly neat and compact, yet his style is in a high degree beautiful and tender, especially when he has occasion to excite the softer passions of grief and pity, which is frequently the case in the earlier parts of his prophecies. These are chiefly poetical. The middle of his book is almost entirely historical, and is written in a plain prosaic style, suitable to historical narrative. On many occasions he is very elegant and sublime, especially in xlvi. to li. 1—39, which are wholly poetical, and in which the prophet approaches very near the sublimity of Isaiah."—*Horne.*

JER-FALCON. (*See* GER-FALCON.)

JERVIN, *jer'-vin*, in Chem., a white crystalline fusible base, found, along with veratin, in the *Veratrum album*, or white hellebore.

JESTER. (*See* COURT FOOL.)

JESUITS, or SOCIETY OF JESUS, *jes'-u-its*, is the name of a religious order in the Roman Catholic church, which rose in influence and power far above all the others. Its founder was St. Ignatius Loyola, but the order owed its greatness more to the shrewd policy and energy of his successors than to the ability of its founder. He was a Spaniard, the son of a nobleman, and was a page at the court of Ferdinand and Isabella. A wound received at the siege of Pampeluna, in the twenty-ninth year of his age, changed his ideas of life, and made him resolve to devote himself to the service of the Church. After a pilgrimage to the Holy Land, he, at the age of thirty, entered the university of Paris, in order to fit himself for the duties of a missionary. He seems to have possessed the rare faculty of attracting around him and swaying minds of superior strength and more varied accomplishments than his own. While at the university, he induced Le Fevre (Faber), Francis Xavier, Laynez, and six other young men, to agree to make a pilgrimage to the Holy Land, and to labour there for the conversion of the Saracens. A war between the emperor Charles V. and the Turks prevented their journey to Jerusalem. They therefore went to different universities in Upper Italy, to gain new associates; and in 1539 Ignatius convoked his companions, and laid before them the plan of a new order, to be called the Society of Jesus. Besides the three vows of poverty, chastity, and obedience, they also bound themselves by a fourth

vow, to go, without hesitation, wherever the pope might send them, in order to labour for the salvation of souls. The order was confirmed by papal bull of Paul III., in 1540. Loyola possessed, in the highest degree, the administrative faculty, which eminently fitted him for carrying out the necessary details of such a work,—classifying the different duties, and distributing the various offices; and hence, in the space of a very few years, the society had established itself in almost every country in Europe, as well as in many places throughout the old world and the new. The Jesuit was a man everywhere in request, as a man perfectly qualified for whatever task he undertook, whether as adviser, confessor, teacher, or superintendent of affairs. The superior thus held in his hand the reins of a spiritual government which was rapidly spreading itself over and beyond the Christianized world. With deep sagacity of the remoter consequences, he strictly forbade any Jesuit to accept ecclesiastical dignities of any sort; but, at the same time, they were not forbidden, but eagerly sought after, the office of confessors to emperors, kings, and princes, and thus they obtained great power, to be used for the advantage of their order and of the Church in general. Loyola expired at Rome, July, 1556, in the sixty-fifth year of his age, after having governed the society for sixteen years. Loyola seems to have been actuated by the belief "t at all things would go well in the world, in a world-wise sense, if it were brought into a state of absolute, unreasoning, ungainsaying submissiveness to a single hand ruling it for its good." At a very early period, however, after the death of Loyola, and while his immediate successors were still living, certain writers gave themselves to the task of moulding an ethical system suited to the varied requirements of the Jesuit confessors, based upon a system of casuistic reasoning which found means to sanction or excuse the deepest crimes. The history of Jesuitism derives a deeper colour and a fouler stain, "not so much because crimes more flagitious were committed by the hands, or at the instigation of Jesuit agents, but because the Jesuit, whether suggesting crimes or employed in smoothing the path of the criminal, or in extracting the sting of remorse, went about the work with refined reasonings, with an apparatus of orderly logic, with a carefully adjusted scheme of spurious ethics, which, as often as it made one man actually a criminal, prepared a hundred for walking in the same path." The casuistry of this body is immortalised in the "Provincial Letters" of Pascal The privileges granted to the order were such as specially enabled them to extend their power. At a time when Protestantism was so weakening the ranks of the Church of Rome, the popes saw the policy of having such a body of men to oppose them as the Jesuits; and hence they received privileges such as no body of men, either in church or state, had received before. They are totally exempted from the performance of those duties which form the chief business of other monks. They do not consume half their time in the repetition of tedious offices; they practise no rigorous austerities, appear in no processions. They are permitted to enjoy not only all the rights of the mendicant and secular orders, but are exempt from all episcopal and civil jurisdiction and taxes, so that they acknowledge no authority but that of the pope and the superiors of their order; and are permitted to exercise every priestly function, parochial rights notwithstanding, among all classes of men, even during an interdict, but also (what is not even permitted to archbishops unconditionally) they can absolve from all sins and ecclesiastical penalties, change the objects of the vows of the laity, acquire churches and estates without further papal sanction, &c. The general, who is at the head of the order, has more absolute power than the general of any other religious order. He is elected for life, appoints nearly all the officers of the order, and receives monthly reports from the provincials, and quarterly reports from the superiors of the professed houses, the rectors of the colleges, and the masters of the novices. Every third year the catalogues of every province, with detailed reports on the capacity and conduct of every member, must be sent to him. The order is divided into provinces, each of which is governed by a provincial; each professed house, or house of full members, is governed by a præpositus; each college by a rector; and each residence by a superior. A provincial congregation consists of all the professed members and such coadjutors as are rectors of colleges. A general congregation consists of all the provincial, and two delegates from each provincial congregation; and meets only for the election of a new general, or for deliberating on subjects of very great importance. The general council, which elects a new general, elects also a monitor, whose duty it is to observe the conduct and actions of the general; and, if necessary, to admonish him; and a certain number of assistants, whose advice the general is bound to seek. A strict examination precedes the admission of new members, and five points are absolute impediments to admission; viz., murder, apostasy or other grievous offences, subjection to a degrading sentence, membership in a monastic order, marriage, and insanity, or decided weakness of intellect. Previous to admission, the novice must make a confession to a superior, of his sins and natural infirmities, his desires, prejudices, &c.; and these confessions must be frequently repeated during the period of his probation. At the same time, the members of the order keep a strict watch over the words and actions of the novices, of whom they are bound to report to the superior whatever of importance they discover in their conduct. The novitiate lasts for two years, during which the novices are not allowed to study, but must devote their whole time to prayer and meditation, the "Spiritual Exercises," a work composed by Loyola, being their chief guide. The novice may then offer himself for admission into the society, and being found qualified, takes the vows of poverty, chastity, and obedience, and becomes a scholastic. In this second stage, he generally devotes fifteen or seventeen years to study and teaching in the colleges of the order, first studying belles-lettres, rhetoric, philosophy, the physical and mathematical sciences; then teaching in succession various branches; and afterwards spending four or six years in the study of theology and the oriental languages. The candidate then spends a second novitiate, lasting for one year, during which he lives in retirement, making himself acquainted with the constitution of his order, and preparing himself for receiving the final degree of the order. A detailed report is then made by his superior to the general of the order, and in accordance with this he is admitted to the rank of either *coadjutor spiritualis*, or *professus*. The coadjutors have on the whole the same rights as the professi, but cannot take part in the provincial and general congregations of the order, and cannot be elected to a higher office than the rectorate of a college. The professed members, in whose hands the supreme government of the order lies, take upon themselves the fourth vow to go as missionaries wherever the pope may send them. Besides the above classes of members, there are also lay coadjutors, who are received for domestic employments. The Jesuits wear no monastic habit, but dress in black, nearly like secular priests. The power acquired by the Jesuits, their intrigues, and their misdeeds, speedily rendered them hated and detested in most countries where they were established. The order was suppressed in England in 1604, in Venice 1606, in Portugal 1759, in France 1764, and in Spain 1767. In 1773 the order was totally suppressed by decree of Pope Clement XIV. In Prussia, although they had to abandon the constitution of the order, they were permitted to continue as an organised society till the time of Frederick William II. In Russia also the order found an asylum, from which they were not expelled till 1817. On the 7th August, 1814, Pius VII. issued a bull, by which he restored the order, with all the privileges which it possessed at the time of its suppression. The Church of Rome had felt its hold over the minds and consciences of the people being gradually diminished by the diffusion of heresy and atheism, and this seemed the most likely means by which it might be restored. A novitiate was opened at Rome on 11th November, 1814, and received in 1824 the direction of the *Collegium Romanum*, and in 1826 that of the Propaganda. In Modena, Sardinia, and Naples, they were restored in 1815, and reinstated in the possession of a part, or the whole, of the former property of the order, and several new houses were established.

They returned to Lombardy in 1837, to Parma and Venice in 1844, and to Tuscany (for a short time) in 1846. The revolution of 1848 endangered their existence in all Italy; mobs attacked their houses in Genoa and Naples, and they were expelled from nearly every state, even from the dominions of the pope. After the success of the counter-revolution in 1849, they returned to most of the states, except Sardinia and Tuscany; but they were again expelled by the revolutions of 1859-60 from Lombardy, Parma, Modena, and Naples. The order has again obtained a footing in most of the countries of Europe, and in various parts of the New World; and in some countries there are considerable numbers of them. In the 19th century, however, the order possesses little of the power which it wielded in the 17th, nor is it of the nature of things that it should be so. The diffusion of knowledge, the general formation of enlightened views, the advances of science, are all against the extension of the power of this system "Jesuitism we must believe to be in itself unchanged and unchangeable;" but "those things in which consist the welfare of nations are every year coming to be better understood than heretofore; the folly—not merely the criminality—of violence, of ambition, of political fraud and chicane, is coming to be more and more seen and felt; the few and the intelligible axioms of private morality, embodying the requirements of truth, honesty, and open dealing, are now in course of being applied more and more widely to the public conduct of public men, and also to the policy of governments.......Those, therefore—the conspirators against the rights and liberties of mankind—whose practices lead them to court the hour of darkness, will find themselves continually driven into narrower and still narrowing corners, until at length the world will rid itself of them for ever."—(*Taylor*)—Ref. *Jesuitism*, by Isaac Taylor, in *Encyclopædia Britannica*; A. Steinmetz's *History of the Jesuits*, 3 vols. London, 1848; Abbé Guettée's *Histoire des Jésuites*, 2 vols. Paris, 1858-9; Cretineau-Joli's *Histoire religieuse, politique et littéraire de la Compagnie de Jésus*, 6 vols. Paris, 1844-6.

Jet, *jet* (Du. *git*, Fr. *jayet*), a solid, dry, inflammable fossil substance, susceptible of a good polish, and glossy in its fracture, which is conchoidal or undulated. It has a resinous lustre, and a spec. grav. from 1·25 to 1·30. The colour of jet is a pure and deep black, with sometimes a tinge of brown. It occurs in opaque compact masses, so solid and hard that they can readily be turned in a lathe. By friction it acquires a weak electricity, even when it is not insulated. Sometimes it presents the form of branches of trees, and exhibits traces of a ligneous texture. When burning, it has a flame often greenish in colour; but it does not melt like solid bitumen. It exhales during combustion a strong and sometimes aromatic odour, sensibly different from that of coal or bitumen. It is most frequently found in detached masses, of a moderate size, in beds of sandstone, marl, limestone, and secondary trap, and is connected with coal formations, especially those that are associated with secondary trap rocks. In Galicia and other parts of Spain, and in Wittenburg in Saxony, good specimens of jet are obtained, also in the department of Aude, in France, where it sometimes contains amber. In England, it is found near Whitby. It occurs in trap rocks in the Faroe Islands, and in the Isle of Skye, and in the coal formation in Massachusetts, in America. Although used for fuel in some parts, jet is more frequently cut and polished for ornamental purposes, necklaces, bracelets, buttons, &c. By some mineralogists jet is considered as being intermediate between bituminous wood and coal.

Jet d'Eau, *jet do'*, a French term, largely used in England, signifying a fountain which throws up a stream of water to a great height in the air. (*See* Fountain.)

Jetsam, Jetzon, or **Jotson**, *jet'-säm* (Fr. *jeter*, to cast away), in Law, is anything thrown out of a ship being in danger of a wreck and cast on shore.

Jetty, *jet'-te* (Fr. *jetée*), a small pier or projection into a river, for narrowing it and raising the water above that place. A jetty-head is the projecting part of a wharf, or the front of a wharf whose side forms one of the cheeks of a dock.

Jeu d'Esprit, *zhe(r) des-pree'* (Fr., meaning *a game of wit*), a term applied to a witticism formed from some unexpected association of ideas. Bouillet, in his "Dictionnaire des Sciences, des Lettres et des Arts," enumerates charades, enigmas, acrostics, and similar efforts of genius, as coming under the general appellation of *jeu d'esprit*.

Jeux Floraux, *zhe(r) flor-o'* (Fr., floral games), is the name given to a poetical contest which takes place annually at Toulouse, in France, under the presidency of the *Académie des Jeux Floraux*. It originated in the early part of the 14th century, in an attempt by the citizens of Toulouse to revive the poetry of the Troubadours. Seven persons were united into a society under the name of the *Sept Trobadors de Tolosa*, and, in 1323, they sent a letter in verse to all the poets of Provence, inviting them, on the 3rd of May, 1324, to a poetical contest, when the composer of the best poem was to receive a violet of fine gold. The celebrated troubadour Arnaud Vidal gained the prize. Two other prizes were soon after added, to increase the splendour of the festival,—a wild rose and a pansy, both of silver. Similar institutions were afterwards established at Barcelona and Tortosa, and the original institution began to decline, and at the end of the century was nearly extinct, when it was revived by Clemence Isaure, who left by will a considerable sum for the continuance of this festival. More costly flowers now rewarded the talent of the competitors. Four prizes were now offered,—an amaranthus of gold of the value of 400 livres, for the best ode; a violet of silver, of the value of 250 livres, for the best essay in prose; a silver pansy, value 200 livres, for an eclogue, elegy, or idyl; and a silver lily, value 60 livres, for the best sonnet or hymn in honour of the Holy Virgin. It afterwards took the name of *Académie des Jeux Floraux*, and was made to include a chancellor, 35 mainteneurs or judges, and 20 masters. Afterwards, in 1773, the office of chancellor was abolished, and now one of the members presides, with the title of *modérateur*, and is appointed by lot every three months. The seal of the society is kept by a standing secretary. After an interruption of fifteen years, from 1790 to 1806, the academy again assembled for the awarding of prizes, and, since that time, the festival has been annually celebrated.

Jew, The Wandering, *ju*, a mythical personage who forms the subject of many popular traditions. According to one account, he was a carpenter; and as our Saviour passed his workshop on his way to execution, the soldiers begged that he might be allowed to enter for a few moments and rest; but he not only refused, but insulted him. By another account he was a shoemaker, sitting at his bench as our Saviour passed to Calvary, and not only refused to allow him to rest for a few moments, but drove him away with curses. Jesus calmly replied, "Thou shalt wander on the earth till I return." Driven by fear and remorse, he has since wandered, according to the command of our Lord, from place to place, and has in vain sought death amid all the greatest dangers and calamities to which human life is subject. The legend first appears in the Chronicle of Matthew Paris, in the 13th century, where the Wandering Jew is called Cartaphilus, and is said to have been a servant of Pilate. His name in the later legends is Ahasuerus. In the 16th and 17th centuries there appeared several impostors claiming to be the Wandering Jew. This legend has formed the subject of long poems by Schubart and Mosen; of a tragedy by Klingemann; of a mystico-philosophical drama by Edgard Quinet; of prose romances by the Rev. George Croly ("Salathiel"), Alexander Dumas the elder (Isaac Lakadem), Eugene Sue, M. Oelckers, and David Hoffman ("Chronicles selected from the Originals of Cartaphilus, the Wandering Jew," London, 1854); of the poem of the "Undying One," by Mrs. Norton; and of numerous small lyrical pieces.

Jewellery, or **Jewelry**, *jew'-el-e-re, jew'-el-re* (Du. *juweel*, Ger. *juwel*, a jewel).—In the primary acceptation of the word, the term jewellery is applied to any ornaments made of precious stones set in gold or silver for the adornment of the person. In an extended sense, it includes any small article made of gold or silver, even though no precious stones or jewels be used in its manufacture. The principal of the precious stones or gems are described under their respective headings. (*See* Amethyst, Diamond, Emerald,

GEMS, RUBY, SAPPHIRE, &c.) The work of preparing the stones, by cutting them into a suitable form and polishing them, belongs to the lapidary. (*See* LAPIDARY-WORK.) It is the peculiar province of the jeweller to make settings of metal for the stones, and secure them therein, and to manufacture trinkets of any kind in gold or silver, whether in combination with jewels or not. The settings of ornaments are made by casting the metal in small moulds or stamping it with dies, after which a finish is given by chasing, burnishing, and lacquering. Gems are fixed in their setting by cement and the aid of the blowpipe, a small hammer, and some very fine files. Articles of jewellery are not required to have the "hall mark," or the stamp of Goldsmiths' Hall, upon them, which must be placed on all articles of plate made by goldsmiths. This is done to prevent the reduction of the gold below a certain standard, by the addition of too much alloy to the pure metal. The value of gold is estimated by the ratio that exists between the gold and the alloy, the whole mass being considered to be divided into 24 equal parts. Thus, pure gold is spoken of as being "24 carats fine;" old standard or sterling gold, as being 22 carats; and new standard gold 18 carats; which means that sterling gold contains 22 parts of gold to 2 of alloy, and new standard gold 18 parts of gold to 6 of alloy. This is the lowest standard of gold admitted at Goldsmiths' Hall. Pure gold, or gold of 22 carats, is too soft for the purposes of the jeweller; and as articles of jewellery bear no mark to determine the quality of the gold, purchasers who have no means of testing it may often be led by specious announcements to give a high price for a chain or ornament of no intrinsic value. Gold used in jewellery may be mixed with such a large proportion of alloy as to be comparatively worthless, while it presents a fair appearance to the sight. The tint of the metal or composition may be made paler or deeper, according to the preponderance of silver or copper in the alloy; and the introduction of zinc has the effect of improving the appearance of the metal, and rendering its similitude to pure gold still greater; while the intrinsic value of the composition thus produced is very small.

JEWELLING, *jew'-el-ling*, a term particularly applied to the art of setting precious stones of a hard nature in different parts of a watch, so that the spindles or pivots of the wheels may work in them. After the watchmaker has bored holes in the various pieces of the watch in the exact spots where the jewels are to be inserted, the parts are sent to the jeweller, who enlarges the holes on one side of the plate in such a manner that the small ring of brass in which the stone has been set may sink into it. He must, however, always take care that the centre of the hole made by the watchmaker may coincide with the centre of the cavity that he himself has hollowed out to receive the jewel and its setting. After the jewel has been fitted into the cavity, it is secured in its place by two screws with broad heads, which project over the setting and prevent it from slipping out. The jewel and its setting is always let into the plate deep enough to allow the latter to be flush with it. When a jewel is required with a hole right through it, one stone is sufficient, which is drilled and let into the plate in the manner described above; but when a cavity is required in the stone instead of a complete perforation, so that the end of the pivot may have something to work against, two stones are used, fixed in separate settings,—one of which is bored right through, while the other is not pierced at all, but serves to close the hole made in the first stone on one side of it, by fitting over it. In this case the jeweller cuts away the metal of the plate about the hole that is to be jewelled, deep enough to receive the two settings, which he places in the cavity one above another, taking care that the surface of the last may be flush with the plate, after which he secures them by screws as before. The stones are fixed in the setting by turning a hollow in the ring to receive the jewel, and pressing a thin brass rim, which is left for the purpose, closely about the stone with a burnisher. Diamonds for end-pieces, however, are generally brazed into settings of steel. The jeweller cuts the jewels to the required shape, and polishes them in a small lathe on a little disc of copper, which is charged with diamond-powder, known in the trade as "bort." The holes in the stones are drilled by means of small drills of steel, diamond-powder and oil being introduced into the cavity while the process of drilling is going on. The stones are finally polished by rubbing them on a piece of plate-glass on which a little diamond-powder and oil has been placed.

JEW'S EAR. (*See* EXIDIA.)

JEWS' PITCH. (*See* ASPHALT.)

JEW'S-HARP, an insignificant instrument of music, the form of which is too well known to need description. It is a mere plaything, and is totally incapable of being played in conjunction with either the voice or other instruments; its sounds are produced by holding it between the teeth and striking the projecting end of an iron spring with the finger. It is sometimes called the Jew's trump, and is vulgarly believed to derive its name from the Jews, and to be employed in their music. This is, however, entirely wrong, as they do not possess any instrument of the kind, and its present name is most probably a corruption of the French *jeu-trompe*, a trump to play with; or it may come from what seems to be its proper name, and what it is often called, *jaw's harp*, from its being played between the teeth.

JEW'S MALLOW. (*See* CORCHORUS.)

JIB, *jib*, the foremost sail in a ship, extending from the outer end of the jib-boom towards the *foretop* masthead. In cutters and sloops it is placed upon the bowsprit, and extends to the lower masthead. A flying jib is a sail which is occasionally set upon a boom rigged out beyond the jib-boom. The jib-boom is a continuation of the bowsprit forward, to which it is usually secured by means of two large boom-irons, or sometimes by only one, and a cap on the outer end of the bowsprit.

JIG, *jig* (Ital. *giga*, Fr. *gigue*), a quick, animated dance-tune, supposed to have been of English invention, although the term is derived from the Teutonic *gieg*, or *gheige*. Jigs were very popular amongst most Europeans. In Bartholomew Fair they were danced by buffoons during the exhibitions of Dives and Lazarus, and scriptural stories.

JOAN, POPE, *jone*, is a fictitious personage, who was long supposed to have succeeded Leo IV. in the papal chair in 855, and to have occupied it above two years. She is said to have been a native of Mentz, who, falling in love with an Englishman at Fulda, travelled with him, and studied at Athens and Rome, concealing her sex, and taking the name of Johannes Angelicus. She became distinguished for her talents and learning, and rose at length to the papal chair, under the name of John VIII. She governed well, but having become pregnant, she was seized with the pains of labour one day in procession, and died in the street, near the Coliseum. The story is first mentioned by Marianus Scotus, a monk in the abbey of Fulda, in the 11th century; but it has been sufficiently disproved.

JOB, BOOK OF, *jobe*, is the name of one of the books of the Old Testament, so called from the patriarch whose history and whose patience under adversity and suffering it depicts. Many questions have been agitated with respect to this book, particularly regarding the reality or fiction of the history, the period in which the author lived, and the piety and ethics which the book is intended to teach. Many eminent critics have endeavoured to prove that the whole poem is a mere fictitious narration, intended to instruct through the medium of a parable, while the actual truth of the narrative has been maintained by men equally distinguished, and has, besides, been the uniform belief both of the Jewish and the Christian church. Besides, Job is spoken of in several other passages of Scripture as being a real personage. "Ye have heard of the patience of Job," says the apostle James. As to the age in which he lived, there is great diversity of opinion. Some regard him as living in the time of the patriarchs, others in the time of Moses, others during the Judges, others in the reign of Solomon, others in the time of the Captivity, &c. The book itself bears undoubted marks of antiquity. The Usserian, or Bible chronology, dates the trial of Job about the year 1520 B.C., or twenty-nine years before the departure of the Israelites from Egypt. In support of its high antiquity, have been adduced, besides the general air of antiquity which pervades the manners

recorded in the poem, the longevity of Job, which was characteristic of early or patriarchal times; his holding the office of priest in his own family; his allusion to that species of idolatry alone which is generally admitted to have been the most ancient,—that of the heavenly bodies; and the silence of the book respecting the history of the Israelites and the Mosaic laws. Dr. Hales has, by means of astronomical calculations, based upon the position of the stars referred to by Job, attempted to fix the date of his trial, and makes it to have been 184 years before the birth of Abraham. The scene of the poem is stated to be the land of Uz, which most probably is Idumæa. The different parts of the book are so closely connected together, that it must all have been the work of one author, and many conjectures have been made as to who that author was. Elihu, Job, Moses, Solomon, Isaiah, Ezekiel, and Ezra, have all been brought forward as having written it. There is no reason, however, to doubt, indeed, it is highly probable that Job was the writer of his own story, of whose inspiration we have the clearest evidence, when he says, "I have heard of thee by the hearing of the ear, but now mine eye seeth thee" (xlii 5). In this book we have an account of a man of distinguished wealth, as well as of eminent piety, suddenly precipitated from the very summit of prosperity into the lowest depths of misery and ruin, —first bereaved of his wealth and children, and afterwards afflicted with a loathsome and excruciating bodily disease. Yet, under these heavy afflictions, we are told that he sinned not, nor charged God foolishly. He is visited by three of his friends, Eliphaz, Bildad, and Zophar, on the pretence of affording him consolation. After a long silence, Job's grief breaks forth into passionate exclamations, and a vehement execration of the day of his birth. The minds of his friends are suddenly exasperated, and their consolation, if any was intended, is changed into contumely and reproaches. Eliphaz reproves his impatience, questions his integrity, by insinuating that God does not so punish the righteous, and finally admonishes him not to despise the chastisement of God (iv., v.). Job replies, apologizing for the intemperance of his grief by the magnitude of his calamities; prays for speedy death, accuses his friends of cruelty, and supplicates the mercy of God (vi., vii.). The argument of Eliphaz is resumed by Bildad, who reproves Job with still greater acrimony, telling him that the death of his children had been owing to their transgressions, and that he should reform, not murmur (viii.). In reply, Job acknowledges the justice and sovereignty of God; argues that his afflictions are no proof of his wickedness; and, in despair, again wishes for death (ix., x.). Zophar prosecutes the argument with still greater severity, and exhorts him to repentance, as the only means by which to recover his former prosperity (xi.). Job replies, censuring their pretensions to superior wisdom, charging them with hypocrisy and uncharitableness, and appealing to God, professing his hope in a future resurrection (xii.—xiv.). The second series of controversy begins with another speech from Eliphaz, who accuses Job of impiety in justifying himself (xv.). Job replies, complaining of the increasing unkindness of his friends, protests his innocency, and looks to death as his last resource (xvi., xvii.). Bildad continues his former line of argument with increased asperity, inculcating the general idea that Job's sufferings are the tokens of God's displeasure at his wickedness (xviii.). In reply, the sufferer complains bitterly of the cruelty of his friends and the hard treatment of God; also he craves pity, and professes his belief that God would yet appear to vindicate his cause against his accusers (xix.). The second speech of Zophar enlarges upon the sure downfall and portion of the wicked (xx.). Job, on the contrary, dwells upon the fact that the wicked are often prosperous in this world, and end their days in peace (xxi.). The third series of controversy is opened by Eliphaz asserting more directly than before that Job's misfortunes were the result of his crimes, and concludes with renewed exhortation to repentance and prayer (xxii.). In reply, Job ardently desires to plead his cause before God, and maintains that the wicked frequently escape punishment in this life (xxiii., xxiv.). The reply of Bildad, who expresses the holiness of God, before whom no man can be pure (xxv.). Job, in reply, revindicates his own conduct with great warmth; takes a retrospect of his former life as a husband, a master, a magistrate; and concludes with an ardent wish for an immediate trial before God's tribunal (xxvi.—xxxi.). Another speaker is now introduced, Elihu by name, who sums up the whole argument. After condemning the conduct of all the disputants, whose reasonings were not calculated to produce conviction (xxxii.), he proceeds to contest several of Job's positions, and to show that God frequently afflicts the children of men for the best of purposes, and that, in every instance, it is our duty to submit. He concludes with a fine description of the various attributes of God (xxxiii.—xxxvii.). Jehovah himself now interposes, and addresses Job out of a whirlwind, in a speech of the sublimest kind. He shows Job the folly of questioning the justice or wisdom of the Divine government, when he is unable to control, or as much as comprehend, the commonest phenomena of nature (xxxviii.—xli.). Then follows Job's submission, and his restoration to prosperity, his possessions being doubled (xlii.). Some commentators have regarded this book as a regular epic, possessing unity of action, delineation of character, plot, and catastrophe,—not exactly in the Grecian, but in the Oriental style; others regard it as a regular drama, divided into acts and scenes; while others call its form lyrical. But, whatever class of poetry we regard it as belonging to, it stands in the first rank of Hebrew poesy. "The poetry of the book of Job," says Dr. Blair, "is not only equal to that of any other of the sacred writings, but is superior to them all, except those of Isaiah alone. As Isaiah is the most sublime, David the most pleasing and tender, so Job is the most descriptive of all the inspired poets. A peculiar glow of fancy and strength of description characterize the author. No writer whatever abounds so much in metaphors. He may be said not to describe, but to render visible, whatever he treats of."—*Ref.* Horne's *Introduction to the Holy Scriptures*.

JOEL, BOOK OF, *jo'-el*, the name of one of the books of the Old Testament, called after its author, who is one of what are termed the minor prophets. He lived in Judah, but under what reign is doubtful, some placing him under Uzziah, others under Joash, &c. The book consists of two parts; the first (i. 2—ii. 18) giving a description of a famine caused by the ravages of locusts, and exhorting the people to repentance, in which he becomes very urgent towards the close, denouncing still greater judgments against them if they continue impenitent; and the second part (ii. 19—iii. 21), containing the divine promise respecting the removal of this judgment upon the people, the destruction of all nations hostile to the theocracy, and the glorification of that theocracy by the richest blessings of nature and the outpouring of the spirit upon all flesh. The canonicity of this book has never been doubted. The style is pure, elegant, and copious, and the ideas are noble and vigorous.

JOHN BULL, *jon*, a collective name, used in a sportive manner, in order to designate the English people. It was first employed by Dean Swift. Amongst the English themselves, the term is used in order to convey the idea of an honest, blunt, but, on the whole, good-natured character. Amongst foreigners, the term *John Bull* is employed in order to express the insular peculiarities and prejudices of the English nation, and especially their inability to accommodate themselves to the circumstances of foreign countries. The generic sobriquets applied to the inhabitants of other countries differ from the English *John Bull*. Thus, the terms *Sawney* in Scotland, and *Paddy* in Ireland, refer more to individuals than to the Scotch or Irish people generally. The former of these is derived from *Saunders*, a contraction of Alexander, and the latter from *Patrick*. The term *Yankee* also signifies an individual American, particularly a native of the eastern states. It is probably a corrupt Indian pronunciation of the word *English*, whom the Indians called Yengees. *Uncle Sam*, a common colloquial expression, is derived from U.S., the abbreviation of the United States.

JOHN DORY. (*See* DORY, JOHN.)

JOHN, EPISTLES OF, the name of three of the books of the New Testament scriptures, which, though bearing no name, are unquestionably the work of the apostle John. The author of the first epistle describes himself at its commencement, as an eye-witness of the life of our Lord; and the style and language manifestly harmonise with those of the author of the gospel of John. For the authenticity of the first epistle very ancient testimony can be adduced. The design of this epistle is to refute, and to guard the Christians, to whom he wrote, against erroneous and licentious tenets, principles, and practices; to stir up all who profess to know God, to have communion with him, and to believe in him, that they walk in the light and not in darkness, that is, in holiness and not in sin; and to help forward and provoke real Christians to communion with God and Christ Jesus, to constancy in the faith, and purity and holiness of life. The style is simple, clear, and flowing, and the epistle breathes a spirit of love and devotion, with zeal for moral strictness. The second epistle is addressed to Kuria, "the elect lady," and is an epitome of the first, touching in few words on the same points. Kuria is commended for the religious upbringing of her children, and is exhorted to abide in the doctrine of Christ, to persevere in the truth, and carefully to avoid the delusions of false teachers. Chiefly, however, he beseeches her to practise the great and indispensable commandment of Christian love and charity. The third epistle is addressed to a converted gentile, named Gaius, but of whom nothing is known with certainty. Its scope is to commend his steadfastness in the faith and his general hospitality, especially to the ministers of Christ; to caution him against the ambitious and turbulent practices of Diotrephes, and to recommend Demetrius to his friendship, referring what he may further have to say to a personal interview.—*Ref.* Horne's *Introduction to the Holy Scriptures.*

JOHN, GOSPEL OF, is the name of one of the books of the New Testament, written by John the Evangelist and Apostle, the son of Zebedee, and the younger brother of James the elder. The precise date of this gospel is not known, some placing it as early as 68 or 69, others as late as 97. There has been much speculation in modern times as to the object the apostle had in view in writing his gospel. According to some, his design was to supplement the deficiencies of the three other gospels; according to others, to confute the errors of the Nicolaitans and Cerinthus; while others are of opinion that it was to state the true doctrine of the divinity of Christ. Probably all of these and other motives may have been in the mind of the apostle; but, judging from what he himself has said, the last of these seems to have been the main motive. "Many other signs truly did Jesus in the presence of his disciples, which are not written in this book. But these are written, that ye might believe that Jesus is the Christ, the son of God, and that, believing, ye might have life through his name" (xx. 31). The four following doctrines are more particularly insisted upon in this book:—1. The mystical relation of the Son to the Father; 2. that of the Redeemer to believers; 3. the announcement of the Holy Ghost as the comforter; 4. the peculiar importance ascribed to love. It is usual to divide this book into three parts:—1. The Introduction or prologue (i. 1—18); 2. the History, narrating the various events in connection with our Lord's ministry, and giving an account of his death (i. 19—xx. 29); 3. the Conclusion, giving an account of the person of the writer of this gospel, and of his design in writing it (xx. 30—xxi.). No doubt has ever been entertained at any time in the Church, either as to the canonical authority of this book or to its being written by John. The circumstantiality of its details proves it to have been written by a hearer and an eye-witness; besides which there is the uninterrupted testimony of the ancient fathers in its favour.—*Ref.* Smith's *Dictionary of the Bible.*

JOHN'S COLLEGE, ST., CAMBRIDGE, was founded by Lady Margaret, countess of Richmond and Derby, and mother of King Henry VII., in 1511. She died before the full completion of her designs, and much difficulty was experienced in establishing the college on as large a scale as was originally intended; but by the exertions and munificence of Fisher, bishop of Rochester, then chancellor of the university, and others, sufficient funds were obtained to endow thirty-two fellowships. This number was afterwards augmented by numerous subsequent benefactors. The college now consists of a master, fifty-six fellows, and sixty foundation scholars, the fellowships and scholarships being open to all British subjects, without any restriction or appropriation. Candidates for fellowships must be bachelors of arts, law, or medicine; and all fellows, except those holding the office of tutor, &c., are obliged to be in priests' orders within seven years from the degree of M.A. The value of a scholarship is £50 per annum, and is tenable till the scholar shall become of standing to be an inceptor in arts. There are also eight minor scholarships, tenable for two years, and a number of exhibitions attached to this college. The number of undergraduates in 1862 was 218; of members on the boards, 1,442.—*Ref. Cambridge University Calendar.*

JOHN, ST., KNIGHTS OF. (*See* HOSPITALLERS.)

JOINERY, *joyn'-er-e*, a term that may be generally applied to the art of connecting and fitting separate pieces of timber together, whether large or small, but which is more properly confined to the operations of the carpenter, who makes the doors, staircases, window-frames, and other internal fittings of a house, and who is, in consequence called a joiner. One of the most important joints in carpentry is the "scarf," by which two thick pieces of timber are scarfed or fastened together, that they may present the appearance of being one continuous piece of the same width and thickness throughout. It is principally used in preparing the keels of vessels and beams, in which great length is required. Masts are also sometimes joined together in this way. The form of the scarf is various. The most common method is that which is used in fastening small pieces of timber, or the joints of a fishing-rod, together, in which a plain bevelled joint of some length runs diagonally through the piece, and is formed by bringing together the extremities, which have been cut in such a manner that the bevelled surface of the ends of each piece form a very small angle with the external surface of the side that meets it at the sharpened end; but this would not be sufficiently strong for joining together pieces of timber of considerable size; so the ends are generally cut and fitted together in the form of steps, from which this kind of scarf has obtained the name of the "step scarf." The French have a method of cutting the ends of each piece into a sloping zigzag or notched form, which is perhaps better adapted to resist longitudinal tension; but all timbers joined by scarfing should be secured with bolts, having nuts and screws at either end; and it is better to put substantial plates of iron across the ends of the joints that appear in the upper and under surfaces of the beam through which the bolts are passed, so that each end of the scarf is bound and tied together by a framework of iron. Sometimes pieces of iron of some breadth are fitted to the sides of the beam, and fastened together by bolts passing above and below the beam: this plan is adopted when the timbers have to resist any transverse strain. If no bolts are used to strengthen the scarf, it must be much longer, in proportion to the depth of the beam. With bolts, the length of the scarf should be at least twice the depth of the beam in elm, oak, beech, ash, and all kinds of timber of a similar nature to these materials; but in deal, it must be four times the depth. Without bolts, the length of the scarf, for all kinds of wood, must be three times as long as it would be if bolts were used, to add to the security of the joint. When joints are made in timber in which the grain in each piece runs in the same direction, and parallel to the sides of the wood, they are called "longitudinal joints;" but when the grain of one crosses that of the other at right angles, it is called an "abutting joint." A simple method of joining small pieces of timber at right angles to each other is by notching or cutting away half the thickness of the end as far into the length of the timber as may be required. This is done to each of the pieces that have to be fastened together. When two pieces cross each other at right angles, or indeed at any angle, a joint is made in this way, by cutting a piece out of each piece of wood to the extent of half its thickness, and corresponding in width or shape to that of the piece which is to fit into it. When broad pieces of

timber or planks are joined at the ends, they are dovetailed into each other, or notched and dovetailed. The dovetail joint is sometimes used in joining square pieces of wood end to end, but it is not so strong as the scarfed joint for this purpose. Notched joints of any kind, such as those already described, and the notches made to allow the ends of rafters to fit into girders and wall-plates, or to fit against the inner edge of the latter, are always secured by nails or wooden pegs. The joint most commonly used for putting pieces of wood together to form strong rough frames, and for putting together partitions and large structures of timber, is the "mortise-and-tenon" joint. A square hole is sunk in one piece of timber by means of the mortise-chisel and mallet, and the end of the piece of timber that is to fit into it at right angles is cut to the shape of the hole by the tenon saw. When the pieces have been fitted together, the joints are nailed or pegged, or the tenon is locked closely into the mortise by splitting its extremity and inserting one or more thin wedges. The above are the different descriptions of joints used in carpentry. Those adopted in joinery are similar in principle; thus the component parts of the framing of a door or shutter are put together by mortise-and-tenon joints, but the mortises and tenons are long and very narrow, instead of being square, or twice as long as they are broad, as in carpentry, when heavy timbers are fitted together. The dovetailed joint is used for joining the ends of planks that form the sides of drawers and boxes, while different varieties of the mitre joint are used for fitting and joining the corners of picture-frames and ornamental beading placed round a panel. In making staircases, a broad groove is generally cut in the under side of the horizontal board called the head, at a short distance from the edge, or nosing, in front, into which the top of the vertical board, or riser, below it is fitted. This method of joining boards is called notching. In joining the edges of boards to form a plane surface, a rebate is formed in the edge of each plank by cutting it away on one side in the form of a step, and the boards are then fitted over each other; or a groove is cut in the centre of the edge of one board, which receives a corresponding projection formed on the edge of that which comes next to it. Sometimes a groove is cut in the edges of both boards, into which a narrow slip of wood is inserted.—*Ref.* Tredgold's *Elementary Principles of Carpentry;* Nicholson's *Architectural Dictionary*.

JOINT, *joynt* (Ang.-Nor., fr. Fr. *joint*).—In Build. and the constructive arts, this term is applied to the various means that are adopted to connect or fasten any two or more pieces of material together. Joints are of two kinds,—fixed and movable. A rigid or fixed joint is that which serves to unite pieces of wood, stone, or metal together, in such a manner that they may answer the same purpose as a single piece of the same material would, if it could be procured of the requisite shape on the one hand, or of sufficient size on the other, and such as could be readily placed in position. A movable joint is such as enables pieces of woodwork to be attached to each other in such a manner that one may work or turn about the other, as a door moves about the jamb to which it is suspended. The various kinds of joints by which this is effected are described elsewhere (*see* HINGE), and the different methods of connecting pieces of timber are noticed in the preceding article (*see* JOINERY). It will therefore only be necessary, in the present article, to mention the joints that are used in connecting masonry and metal-work. The term joint in masonry is applied for the most part to the vertical junctures of the ends of pieces of stones and bricks, and to the slanting junctures of the voussoirs of an arch. When large blocks of stone are joined together, they are sometimes dovetailed and secured at the top by iron clamps set in melted lead, or they are fitted together by what is termed a "joggle," in which a projection, left on the side of one stone, is fitted into a groove that is cut for its reception in the side of another that is adjacent to it. In joining thick bars and pieces of metal, joints similar in form to those used in carpentry are employed, the pieces being also further and more intimately connected by welding, brazing, or soldering, or by the insertion of iron rivets into holes bored through both of the pieces that are to be fastened together. Welded joints are made by heating the ends of the pieces to a red or white heat, and then hammering them together. Brazed joints consist of the union of the edges of pieces of metal by the aid of an alloy that is mostly made of brass and zinc. Soldered joints consist of the union of a small and narrow part of the surfaces of contiguous pieces of metal lying along the edge of either—the pieces being made to overlap each other about the eighth of an inch, or more if necessary—by an alloy or solder that fuses readily at a low heat. Different alloys are used for joining two pieces of metal of the same kind and two pieces of different kinds.

JOINT, in Anat. (*See* ANATOMY.)

JOINT-STOCK COMPANIES are a kind of partnership entered into by a number of individuals for the purpose of carrying on some trade or business with a view to individual profit. In ordinary partnerships, the members (except in the case of what are termed "sleeping partners") contribute more or less of their own personal labour or management to the affairs of the company. In joint-stock partnerships, on the other hand, the members only contribute to the funds or "stock" of the company, without having any direct share in the management; and hence their name. The capital of the company is generally divided into equal parts, called "shares," a certain number of which are held by each member of the company; and in proportion to the number of these he is entitled to participate in the profits of the undertaking. These shares are freely transferable without the consent of the company. The immediate superintendence of the affairs of the company is usually delegated to a portion of the members called directors, subject, nevertheless, to the general control of the body assembled at stated intervals, or on particular occasions, when they may be convened; except on such occasions, however, the general body of the shareholders have no power to interfere in its concerns or to bind the company. The increased facilities which the wealth and influence of a number of individuals, concentrated in the hands of a few, give for carrying out commercial projects, were seen and taken advantage of early in the history of commerce. The most noted among the earlier associations of this kind was that of the Hanse Towns, which continued to flourish for several centuries. The last three centuries of the history of England afford many instances of memorable joint-stock companies. In 1553 was established the company of "Merchant Adventurers for the Discovery of Lands, Countries, Isles, &c., not before known by the English," which afterwards became the Russian Company, and which, under the fostering care of Queen Elizabeth, acquired so much power as to spread its transactions into Persia on the one hand, and to embark in the whale-fishery of Spitzbergen on the other. The celebrated Turkey or Levant Company was chartered in 1581; and eighteen years afterwards the East-India Company was formed, which has been destined to effect such important results. Many African and American companies were formed in the 17th century, and created much excitement by their rivalries and aggressions. The unfortunate Scottish Darien project was formed in 1695, and the disastrous South-Sea scheme in 1710. These projects are not without their counterparts in more recent times. During the last century, a large number of useful public undertakings, canals, bridges, harbours, docks, water and gas works, &c., have been carried into effect by companies formed on the joint-stock principle; and, more recently, our gigantic system of railways has been formed in the same way. Previous acts having been found ineffectual for the prevention of frauds and irregularities in such companies, act 8 & 9 Vict. c. 110, was passed, which required every company not requiring or obtaining an act of parliament, projected after a certain day, to be registered with the registrar of joint-stock companies, under severe penalties, and rendered all the shareholders liable for the debts of the company. The company, however, had many of the advantages of being incorporated, and could sue and be sued in its proper name. This act was subsequently repealed by 19 & 20 Vict. c. 47, called the Joint-Stock Companies' Act, 1856; amended by 20 & 21 Vict. c. 14, called the

Joint-Stock Companies' Act, 1857. By these two acts it is provided that any seven or more persons associated for any lawful purpose may, by subscribing their names to a memorandum of association, and otherwise complying with the requisitions of the act relative to registration, form themselves into an incorporated company, with or without limited liability. said memorandum, with articles of association (if any), to be delivered to the registrar of joint-stock companies, who shall register the same; on which said company becomes a body corporate, with power to hold lands, &c., as by act provided. A list of the shareholders has to be annually furnished to the registrar of joint-stock companies, and is open to public inspection. Each shareholder is individually liable for the debts of the company, limited, if the company be "limited," to the amount which may still remain due on the shares held by him; or, if "unlimited," then to an amount sufficient to pay the debts of the company, with all costs and expenses. In the case of a limited company, this liability continues for one year after a shareholder may have transferred his shares,—in the case of an unlimited company, for three years; but in the latter case the liability does not extend to such debts as may have been contracted after the date of the transfer. If more than twenty persons unite for the purpose of carrying on any trade or business for gain to the partners, and be not registered or constituted by some act of parliament or royal charter, or engaged in working mines within the jurisdiction of the Stannaries, they shall be severally liable for the payment of the whole debts of the company, and may be sued for the same. A company may be wound up either voluntarily or compulsorily. A company may be voluntarily wound up when a special resolution to that effect is passed at a general meeting, supported by the votes of three-fourths of the shareholders assembled; in which case the official liquidator is appointed by the company itself, and exercises all his powers,—calling upon contributories, &c., without the intervention of any court. A company may be wound up compulsorily,—1. by virtue of a special resolut to that effect; 2. when the company does not commence its business within a year from its incorporation, or suspends business for a year; 3. whenever the shareholders are reduced in number to less than seven; 4. whenever the company is unable to pay its debts; 5. whenever three-fourths of the capital have been lost or become unavailable. A company is deemed unable to pay its debts whenever a creditor for more than £50 has served a demand, under his hand, requiring payment of the sum due, and has not obtained satisfaction within three weeks, when he may take proceedings to have the company wound up. The winding up takes place upon a petition presented by the creditor to the proper court, which, if the company be limited, is the court of Bankruptcy having jurisdiction in the place where the company's registered office is situate; and if the company be unlimited, the high court of Chancery. Such court may accordingly make an order for the winding up, and may appoint, to assist in that operation, an official liquidator, who is to take into his custody all the property, effects, and choses in action of the company, and dispose of them by way of sale or otherwise, under the sanction of the court. He also collects the assets of the company, and applies them in discharge of its liabilities, and may also proceed to make calls on the several shareholders or contributories to the extent of their respective liabilities. As soon as the affairs of the company have been completely wound up, the court shall make order for its immediate dissolution. A petition for winding up a company may be presented by a contributory as well as by a creditor, whenever it is unable to pay its debts. By the Joint-Stock Banking Companies' Acts, 1857, 1858 (20 & 21 Vict. c. 49, and 21 & 22 Vict. c. 91), joint-stock banking companies have been subjected generally to the Joint-Stock Companies' Acts. By the Joint-Stock Companies' Amendment Act (21 & 22 Vict. c. 60), it is declared that any order made by the court in England, for or in the course of the winding up of a company under the Joint-Stock Companies' Acts, shall be enforced in Scotland and Ireland in the courts that would respectively have had jurisdiction in respect of such company, if the registered office of the company had been established in Scotland or Ireland; and in like manner orders or decrees made by the court in Scotland or Ireland, for or in course of the winding up of a company, shall be enforced in England.—*Ref.* Stephen's *Commentaries on the Laws of England*; Smith's *Compendium of Mercantile Law*, by Dowdeswell.

JOINT TENANCY, in Law, signifies the joint ownership of two or more persons in land or other property. The creation of an estate in joint tenancy depends on the wording of the deed or devise by which the tenants claim title; for this estate can only arise by purchase or grant,—that is, by act of the parties, and never by mere act of law. The properties of a joint estate are derived from its unity, which is fourfold:—1. unity of interest,—that is, one joint tenant cannot be entitled to one period of duration or quantity of interest in the lands, and the other to a different; one cannot be a tenant for life and the other for years; 2. unity of title,—their estate must be created by one and the same act, as by one and the same grant; 3. unity of time,—the estate must be vested at one and the same time, as well as by one and the same title, with a few exceptions, as where a feoffment was made to the use of a man and such wife as he should afterwards marry; 4. unity of possession,—that is, each of them has the entire possession, as well of every parcel as of the whole (*per my et per tout*, by the half or moiety, and by all). In all actions relating to their joint estate, one joint tenant cannot sue or be sued without joining the other; neither can one joint tenant by himself do any act which may tend to defeat or injure the estate of the other. The interest of joint tenants being not only equal or similar, but also one and the same, it follows that when two or more persons are seised of a joint estate of inheritance for their own lives, or *pur auter vie*, or are jointly possessed of any chattel interest, the entire tenancy, upon the decease of any of them, remains to the survivors, and at length to the last survivor; and he shall be entitled to the whole estate, whatever it be, whether an inheritance or a common freehold only, or even a less estate. Joint tenants may agree to part their lands and hold them in severalty, when they are no longer joint tenants, and the right of survivorship ceases. Things personal may belong to their owners in joint tenancy as well as real estates. Thus, if a horse or other personal chattel be given to two or more persons absolutely, they are joint tenants thereof; and, unless the jointure be severed, the same doctrine of survivorship shall take place as in estates of lands. Either party may also sell his share, by which the right of survivorship is destroyed. Partners in trade are joint tenants of the partnership stock; but on the death of a partner, his personal representatives become tenants in common in equity with the surviving partners.

JOINTURE, *joynt'-tshur*, in Law, was originally used to denote the interest of joint tenant, but it is now commonly applied to that portion of lands and tenements conveyed to a wife, in the event of her surviving her husband. Before the passing of the Statute of Uses (27 Hen. VIII. c. 10), the greatest part of the land of England was conveyed to uses, and thus not subject to dower; and hence it became usual, on marriage, to settle by express deed some special estate to the use of the husband and his wife, for their lives, in joint tenancy or jointure, which would be a provision for the wife in the event of her surviving her husband. By the Statute of Uses, all wives would have become dowable of such lands as were held to the use of their husbands, and also entitled at the same time to any special lands that might be settled in jointure, had not the same statute provided that upon the husband's making such an estate in jointure to the wife before marriage, she should be for ever precluded from her dower. It must be made before marriage; for if the jointure be made to her after marriage, she has her election after her husband's death, either to accept it, or to refuse it and betake herself to her dower at common law, for she was not capable of consenting to it during coverture. The jointure must be limited to take effect immediately on the death of the husband; it must be for her own life, or during widowhood at least, and not *pur auter vie*, or for any term of years; it must be made to herself, and to no other in trust for

her, although a trust estate is a good equitable jointure, and it must be made in satisfaction of her whole dower, and not of any particular part of it. In consequence of the inconveniences arising from the limitation of land by jointure, it has become common to convert it into an annuity for life, chargeable upon the land, with power of distress, and also right of entering upon the land, in the event of the annuity not being paid. In this way a more certain income is provided for the widow, and the heir obtains possession of the whole estate.

Jonah, Book of, *jo'-nă*, is the name of one of the sacred books of the Old Testament, the fifth in order among those of the minor prophets. Its author, Jonah, was the son of Amittai, a native of Gathhepher, in the tribe of Zebulon, and is generally believed to have flourished during the reign of Jeroboam II., though some place him forty years earlier, towards the close of Jehu's reign. With the exception of the sublime ode in the second chapter, the book of Jonah is a simple narrative. It gives an account of the prophet's commission to denounce Nineveh, and of his refusal to undertake the task; his attempt to flee to Tarshish and its frustration, together with his delivery from the stomach of the great fish, which had swallowed him (i., ii.). He is again sent on his mission, and, in consequence of his preaching, the Ninevites repent in dust and ashes (iii.). Jonah was exceedingly angry at God's merciful forbearance towards the Ninevites, probably dreading lest his veracity as a prophet might be called in question, and retired from the city to a spot from whence he might witness its destruction. God caused a gourd to spring up to shelter him; and from its speedy death he took occasion to reprove Jonah for repining at the divine forbearance. The scope of the book is to show the value of real repentance; and from the conduct of the Ninevites, our Lord takes occasion to reprove the perfidiousness of the Jews. Many have attempted to deny the literal interpretation of this book; some regarding it as an allegory, others as a mere fiction, designed to serve a moral purpose. There are also some who, while not questioning the truth of the narrative, yet have recourse to the most absurd and ridiculous hypotheses in order to explain away the account given of Jonah's being swallowed by a great fish. The word translated whale in the New Testament means any large fish; and the general opinion now is, that the animal was a species of shark, within some of which whole human bodies have been found. From the manner in which the sacred historians and Jesus Christ speak of the incidents of this book, it is evident that it is a true narrative of a real personage, and that Jonah was a prophet of considerable eminence.

Joshua, Book of, *josh'-u-ă*, is the sixth in order of the books of the Old Testament, and is a history of the Israelites under the government of Joshua, the successor of Moses, embracing the period between 1451 and 1425 B.C. The general opinion is that the book was written by Joshua himself (except the last five verses), though some regard it as the work of a later hand. The book may be conveniently divided into three parts:—1. The history of the occupation of the land of Canaan, by the Israelites (i.—xi.), and a recapitulation of the conquests, both of Moses and Joshua (xii.); 2. a description of the land of Canaan (xiii.), and a particular apportionment of it among the different tribes (xiv.—xxii.); 3. the dying address, death, and burial of Joshua (xxiii., xxiv.). The scope and design of the book is to demonstrate the truth and faithfulness of God, in the perfect fulfilment of all his promises to the patriarchs, regarding the possession of the land of Canaan by their posterity. A further design of the book is to show the portion which was allotted to each tribe. The canonical authority of this book has never been called in question, and in all the copies of the Old Testament its place is immediately after the Pentateuch. The style is clear, simple, and unpretending. There is some accidental derangement in the order of the chapters of this book. Chronologically, they should read thus:—"First chapter to the ninth verse; then the second chapter; then from the tenth verse to the end of the first chapter; after which should follow the third and consecutive chapters to the eleventh; then the twenty-second chapter, and the twelfth to the twenty-first chapter inclusive; and, lastly, the twenty-third and twenty-fourth chapters."—(*Horne.*) The Samaritans have two books extant, bearing the name of Joshua, the one being a chronicle of events from Adam to the year of the Hegira 898 (A.D. 1492), and the other a similar chronicle, from the death of Moses to the death of Alexander Severus. Of the latter of these an edition was published in Arabic and Latin, by Juynboll,—Leyden, 1848.

Journal, *jur-năl* (Ital. *giornale*, daily), denotes, properly, a record of daily occurrences; but it is commonly applied to a newspaper, magazine, or other periodical publication; as the proceedings of a society.

Journeyman, *jur'-ne-măn* (from Fr. *journée*, a day's work), was originally applied to one who wrought with another by the day, but is now used to designate any mechanic who labours in his employment for another, whether by the day, month, year, or any other term.

Joust. (*See* Tournament.)

Juan, Don. (*See* Don Juan.)

Jubilate, *ju-bil-ai'-te* (Lat.), is the name given to the third Sunday after Easter, from the practice in the primitive church to commence divine service on that day with the 66th Psalm, *Jubilate Deo omnes terræ*,—Sing to the Lord all ye lands.

Jubilee, *ju'-be-le* (Lat. *jubilum*), one of the Jewish festivals, which was celebrated every fiftieth year. This festival was proclaimed by sound of trumpet throughout the land, on the evening of the day of Atonement. All slaves and captives were to be free, all estates which had been sold reverted to their original proprietors or their descendants, and every man returned unto his family. The ground was not to be sown, nor was that to be reaped which grew of itself during that year. The political object of this institution was to preserve the distinction of tribes and families, and to prevent too great a social inequality among the people, by restoring to each his previous possessions. Some have been of opinion that the jubilee was celebrated every forty-ninth, and not every fiftieth year. According to the Hebrew ritual, not only was every seventh day observed as a period of rest, but likewise every seventh year, when they were to cease from labour, and the land was to remain uncultivated. Hence, it is objected to the fiftieth year, that in that case the land would remain for two consecutive years uncultivated. The language of Scripture, however, is so decided as to the fiftieth year, as to leave no room for entertaining the other opinion. The jubilee did not continue to be observed after the Babylonish captivity. In modern times the term has been applied to the year in which all who visited the church of St. Peter at Rome, for a certain number of days, with pious offerings, received plenary indulgence. A jubilee was first declared by Pope Boniface VIII., A.D. 1300, and was to recur every hundred years; but being the means of bringing vast wealth to the Church, the period was shortened by Clement VI. to fifty years. This period was subsequently shortened by Urban VI. to thirty-three years, and by Paul II. to twenty-five, at which last it still remains. The condition of visiting Rome is no longer in force, certain acts of devotion or charity being substituted for it. The last jubilee of the Church was celebrated in 1850.

Judaism, *ju'-dă-izm*, is a term applied to that religious and moral system of the Jews which was communicated to them by Moses, and which is still observed by them in the present day. Many of the early Christians, even in the time of the Apostles, manifested a Judaizing spirit, and are frequently alluded to by the apostle Paul. After the destruction of Jerusalem, a sect, known by the name of Judaizing Christians, separated themselves from communion with their brethren. They afterwards became merged in other sects.

Jude, Epistle of, *jude*, is the name of one of the books of the New Testament, whose canonical authority has been much disputed in ancient and more recent times. It is placed by Eusebius among the controverted books, as having been rejected by many of the ancients; and Luther, Grotius, Dahl, Michaelis, also call it in question. The doubts thrown upon its genuineness, however, arise solely from the writers being supposed to quote two apocryphal books. As regards the prophecy of Enoch, the language of the author does not imply that he is quoting from any

book; the fact may have been handed down by tradition among the Jews, and the words may have afterwards been copied by the author of the apocryphal book of Enoch, in order to give colour to his forgery. The same remarks apply to the notice of the dispute between the archangel Michael and the devil, respecting the body of Moses, which some consider to have been taken from a book entitled the "Assumption or Ascension of Moses." The author of this book simply calls himself Jude, the brother of James, and servant of Jesus Christ; and hence it has been doubted whether he was Jude the apostle, or Jude the Lord's brother, if, indeed, these were two distinct persons, which is by no means clear. Some suppose the book to have been written about 64 or 66, others not till about 90. The design of the epistle is to guard believers against the false teachers who had begun to insinuate themselves into the Church, and were disseminating dangerous tenets of insubordination and licentiousness. The epistle concludes with admonitions and counsels to believers to persevere in faith and godliness, and to rescue others from the snares of false teachers. The language of the epistle is animated, the expressions are remarkably strong, and the figures and comparisons bold, apt, and striking.

Judex, Judicium, *ju'-deks ju-dish'-e-um* (Lat., judge) —It appears that there was no class among the ancient Romans corresponding to our judges. The judices were not necessarily lawyers, and it would seem that any Roman citizen might act as judex in civil causes. The judices were allowed to have their assessors, learned in the law, to advise with. A judex judged both of fact and law, but only in such cases as were of smaller importance. An *arbiter* determined what seemed equitable in a matter not sufficiently defined by law. The *recuperatores* were another class of judges, and were so called because by them every one recovered his own. The *centumviri* were judges chosen from the thirty-five tribes, three from each, being in all 105, but named by a round number 100. They formed a court in which weighty matters of the law were decided. The *judicia* were of two kinds, *privata* (private) and *publica* (public), the former being civil trials, having relation to differences between private individuals, the latter criminal trials.—(*See* further on this subject, the *English Cyclopædia*—Arts and Sciences.)

Judge, *judje* (Fr. *juge*, Lat. *judex*), is one invested with authority to try any cause or question in a court of judicature, and to pronounce sentence or judgment thereon. The judges of the superior courts at Westminster are appointed by the crown, and do not, as formerly, hold office during pleasure, but (by 12 & 13 Will. III. c. 2) during good behaviour, and they can only be removed on the address of both houses of parliament. Neither do they, as formerly, vacate their seats upon the demise of the crown; and their full salaries are secured to them during the continuance of their commissions. Judges are not liable to prosecution for anything done by them as judges, at least within their own jurisdiction; nor are they in any way punishable for a mere error of judgment or for wrongful imprisonment. Judges are, however, punishable for wilful offences against the duty of their situation. Bribery is punishable by loss of office, fine, and imprisonment. A judge ought to judge by law, and not by examples (*Judex est lex loquens*).

Judges, Book of, *judj'-ez*, is one of the historical books of the Old Testament, containing the history of the children of Israel from the death of Joshua to the time of Eli, during which time the government of the people was in the hands of judges; whence the book takes its name. It comprises the history of about three hundred years, and consists of three parts. The first contains the history of the elders who ruled the Israelites after the death of Joshua, and the subsequent transactions to the commencement of their troubles (i.—iii. 4). In the second part of the book have the history of the judges from Othniel to .... (iii. 5—xvi.); being Othniel (iii. 9), Ehud (iii. 15), Shamgar (iii. 31), Deborah (iv. 4), Barak (iv. 6), Gideon (vi. 11), Abimelech (vi. 12—ix.), Tola (x. 1), Jair (x. 3), Jephthah (xii 7), Ibzan (xii. 9), Elon (xii. 11), Abdon (xii. 13), Samson (xv. 20). The third part gives an account of an idol that was worshipped, first in the family of Micah (xvii.), and afterwards in the tribe of Dan (xviii.); followed by an account of a barbarous act committed by the Benjamites of Gibeah, which led to a war between them and the other tribes, in which the tribe of Benjamin was almost extirpated (xix.—xxi.). In this book we find most remarkable instances of God's dealings with the children of Israel. His justice and mercy are alternately and strikingly displayed: the people sinned, and were punished; they repented, and found mercy. We have also presented to us some illustrious examples of faith and goodness in the characters of Gideon, Barak, Samson, Jephthah, &c. The authorship of the book, and the time at which it was written, are subjects on which considerable diversity of opinion exists. The general opinion, and that which is held by the Jews, is that it was written by Samuel, the successor of Eli, though some have ascribed it to Phinehas, Hezekiah, Jeremiah, Ezekiel, Ezra, &c.; being compiled from the public registers or records of the events. The canonical authority of the book is undoubted.

Judgment, *judj'-ment* (Fr. *jugement*, Lat. *judicium*), in Law, is the sentence pronounced by a court of law upon the matter contained in the record. It is restricted to the decisions of a court of common law,—those of a court of equity being denominated decrees. Judgments are of four sorts:—1. On *demurrer*, where the *facts* are confessed by the parties and the law determined by the court; 2. on *verdict*, where the law is admitted by the parties and the facts disputed; 3. by *confession* or *default*, where both the fact and the law arising thereon are admitted by defendant; and, 4. on *nonsuit* or *retraxit*, where the plaintiff is convinced that either fact or law, or both, are insufficient to support his action, and therefore abandons or withdraws his prosecution. All judgments are either interlocutory or final. Interlocutory judgments are such as are given in the middle of a cause. (*See* Interlocutor.) Final judgments, on the other hand, are such as at once put an end to the action, by declaring that the plaintiff has either entitled himself, or has not, to recover the remedy he sues for. Judgment may, for certain causes, be suspended, or finally arrested. Formerly it could not be entered till the next term, after trial had, and that upon notice to the other party; but now, by the Common Law Procedure Act, 1852, a plaintiff or defendant having obtained a verdict, judgment may be signed thereon in fourteen days, unless otherwise ordered by the judge. The judge may also order immediate judgment and execution. If any defect of justice happened at the trial, by surprise, inadvertence, or misconduct, the party may have relief by a new trial; or if, notwithstanding the issue of fact so regularly decided, it appears that the complaint was either not actionable in itself, or not made with sufficient precision and accuracy, the party may supersede it by arresting or staying the judgment. A sufficient ground must, however, be laid before the court to satisfy them that it is necessary to justice that the cause should be further considered. The costs of the suit (after being taxed) generally fall to be paid by the party against whom judgment is delivered. Judgment being signed, the party in whose favour it is given may immediately sue out execution thereon, before the judgment is entered on the roll. In criminal cases, judgment, unless any matter be offered in arrest thereof, follows upon conviction, being the pronouncing of that punishment which is expressly ordained by law.

Judgment, in Log., is that operation of the human mind through which, by joining different ideas together, it affirms or denies the one or the other; as when, for instance, having the ideas of the earth and roundness, it affirms or denies that the earth is round. Our judgments, according to Aristotle, are either problematical, assertive, or demonstrative. The problematical judgment is merely based upon opinion; but it may be the expression of our presentiment of certainty, and may afterwards be proved to demonstration; or it may be only an opinion in which we must admit the possibility of error at the moment of making our decision. The assertive judgment is one of which we are fully persuaded ourselves, but cannot give grounds for our belief that shall compel men in general to coincide with us. The demonstrative judgment may

be either certain in itself, as a mathematical axiom is, or capable of proof by means of other judgments, as the theories of mathematics and the laws of physical science. When expressed in words, a judgment is called a proposition. (*See* PROPOSITION.)—*Ref.* Thomson's *Laws of Thought*.

JUDGMENT NON OBSTANTE VEREDICTO, a legal term applied to the leave granted to a plaintiff by the cour to sign judgment, even after the jury have found fo the defendant, in consequence of the defence put upo the record being not a legal defence in point of sub stance. The merits of the case, however, must be ver clear; and when the plea contains no confession of th cause of action, the proper course which ought to b pursued, is to award a repleader, and not to give judgment *non obstante veredicto*. No defendant can obtai this judgment in any case, but he can arrest it. It must be moved for, according to the language used in Wharton's "Law Lexicon," within four days from the time of trial, if there are so many days in term, and it cannot by any means be moved for after the expiration of the term, provided the jury precept be returnable in the same term. "The judgment is interlocutory; after which a writ of inquiry must be executed, and final judgment signed, as in ordinary cases. If th defendant has succeeded in any of his pleas, he will b entitled to retain his verdict on them, and there mus be a trial *de novo*: the successful party is entitled to the costs of the material issues."—Ref. 2 *Chit. Arch. Prac.*, by Prew, 1843.

JUDICIUM DEI, *ju-dish'-e-um de'-i* (Lat., judgment of God), a term applied in the middle ages, in reference to all extraordinary trials of secret crimes; such as those by arms, single combat, ordeals, walking over red-hot ploughshares, &c., in which it was believed that God would interfere to clear the innocent and to punish the guilty. This practice was long observed, even among Christians. The trial usually took place in the church, in presence of the bishop, priest, and secular judge, generally after a period of fasting, and after many adjurations and ceremonies. The system is very ancient, and has prevailed among various nations other than Christians. It was known to the ancient Greeks; for in the "Antigone" of Sophocles a suspected person declares himself ready to handle hot iron and to walk over fire in order to manifest his innocence.

JUDITH, BOOK OF, *ju'-dith*, the name of one of the apocryphal books of the Old Testament, giving an account of the invasion of Judæa by Holofernes, general of Nabuchodnosor, king of Assyria; and of the delivery of the town of Bethulia, in Judæa, the destruction of the Assyrian army, and the death of Holofernes through the stratagem and courage of Judith, an inhabitant of that town. The historical and geographical difficulties of this book are too great to admit of its being literally true, or even carefully based on truth. The general opinion among critics is, that it is a Jewish romance, written, probably, in the age of the Maccabees, in order to animate the Jews in their struggles against the Syrians. It is disputed whether the original language of this book was the Chaldee or the Greek. The Latin translation by Jerome is from the Chaldee, the English translation in the authorized version from the Greek. The two differ from each other in many respects. There is also a Syriac version which w made from the Greek.

JUGGERNAUT, *jug'-ger-nawt* (Hind.), 'the lord of the world,' a name applied to one of the most celebrated of the sacred temples of India, which is built at Cuttack, on the coast of Orissa. The deity worshipped in the temple of Juggernaut is Vishnu, the *Preserver* (*see* HINDOO RELIGION), under the form of a hideous idol, carved out of wood, with a black painted face and widely-extending red mouth. On the great religious festival of Juggernaut, this idol is placed in a tower fully sixty feet high, moving on wheels; and there are two other idols which accompany the former; viz., his "white brother Balaram" and his "yellow sister Shubudra," who likewise sit on separate thrones. The tower is drawn along then by ropes, which are pulled by the people, and during its progress numbers of fanatics throw themselves beneath its wheels and are crushed to death, in the belief that they thus obtain an entrance into Paradise. Twice a year, pilgrims from all parts of India flock to this temple, and the revenue derived from this pressure used to exceed £12,000 per annum.

JUGGLERS, *jug'-glers*, are such as perform tricks of legerdemain by quick and artful motions of their hands, bodies, and limbs, and, by various preparations, delude the senses, so that the spectators fancy that they hear and see what they really do not hear and see. The name is said to be derived from the French *jongleurs*, the name given to the instrument-players who accompanied the troubadours, and who are said to have afterwards employed themselves in tricks and games. "The arts of juggling," says Beckmann, "convey instruction in the most acceptable manner, and serve as a most agreeable antidote to superstition, and to that popular belief in miracles, exorcism, conjuration, sorcery, and witchcraft, from which our ancestors suffered so severely." This art is one of great antiquity, and in early times was employed as a means of sustaining the power of the priesthood. The magicians of the ancient Egyptians, Persians, &c., were of this class; and doubtless most of the miracles ascribed to the heathen deities were effected by sleight of hand. The investigations of Salverte have shown in what manner most of these could have been done, and with what effect, in the depths of temples, before witnesses filled with awe and devoid of doubt. Feats of agility, as tossing knives and balls, balancing the body in the most dangerous positions, were practised in ancient as well as in modern times. Ancient jugglers performed extraordinary feats by mechanism, which is defined by Cassiodorus as "the science of constructing machines whose effects shall seem to reverse the order of nature." The Egyptian priests made gods and statues which prophesied and explained dreams. In the East, particularly in India and China, jugglery is largely practised, and brought to great perfection as an art. Many of the tricks of modern Eastern jugglers have not yet been found out. The more remarkable jugglers of modern times have been Pinetti, Eckhartshausen, and the famed Katterfelto. More recently we have had Bosco, Houdin, Anderson, Hermann, Heller, Bartolommeo, &c. Most eminent of these is the Frenchman Robert Houdin, whose memoirs were published in 1859.—*Ref.* E. Salverte, *Des Sciences occultes*, 1843; Sir D. Brewster, *Letters on Natural Magic*; K. D. Eckhartshausen, *Ueber die Zauberkräfte der Natur*, 1819.

JUGLANDACEÆ, *ju'-glän-dai'-se-e* (from Lat. *Jovis glans*, the nut of Jupiter, on account of its excellence), in Bot., the Walnut fam., a nat. ord. of *Dicotyledones*, sub-class *Monochlamydeæ*, consisting of fine trees with the following characters:—Leaves alternate, pinnate, exstipulate; flowers unisexual, the male in aments with calyx 2—6-partite, irregular—the female solitary, or in small terminal clusters; calyx superior, regular, 3—5-lobed; ovary inferior, 2—4-celled at base, and 1-celled above; ovule solitary, erect. The fruit called a *tryma*; seed 2—4-lobed, without albumen; embryo with sinuous oily cotyledons, and a short superior radicle. There are 5 genera and 27 species, chiefly natives of North America; a few are found in the East Indies, Persia, and the Caucasus. They are remarkable for their valuable timber and oily edible seeds. (*See* CARYA, JUGLANS.)

JUGLANS, *ju'-glănz*, in Bot., the Walnut, the typical gen. of the nat. ord. *Juglandaceæ*. *J. regia*, the common walnut-tree, is a native of the countries between Greece and Cashmere, but has long been naturalized in the western parts of Europe. It is a very beautiful and valuable tree. The timber is hard, of a rich deep brown, and beautifully marked; it is used for ornamental furniture, handles of tools, and gun-stocks. The seed of this tree is the well-known edible walnut. This yields, by expression, a useful fixed oil of a drying nature, like linseed oil. The bark possesses carthartic properties. *J. nigra*, the black walnut, a native of North America, is also esteemed for its timber. *J. alba*, the white walnut, or butter-nut, is another useful timber tree with edible seeds. The inner bark of the root is used in North America as a mild purgative.

JUGULAR VEINS, *jug'-gu-lar* (Lat. *jugulum*, the neck), in Anat., is the name given to the veins which run down the sides of the neck, and carry the blood down-

wards from the head. They are divided into external and internal; the two afterwards uniting and going with the subclavian vein to form the superior *vena cava*, which terminates in the superior part of the right auricle of the heart.

JUJUBE, *ju-jube'* (Arab.), a term properly applied to the fruit of *Zizyphus vulgaris* and *Z. Jujuba*, closely resembling a small plum, and sometimes used as a sweetmeat. The articles of confectionery called jujubes are composed merely of a mixture of gum-arabic and sugar slightly coloured.

JULIAN ERA. (*See* CALENDAR.)

JULIAN PERIOD, *ju'-le-an*, an arbitrary period of time invented by Joseph Scaliger about 1580, and produced by multiplying the solar cycle 28 by the lunar or Metonic cycle 19 and the Roman indiction 15. It was introduced by Scaliger to enable dates of events occurring before the Christian era to be computed more readily, as authorities differ to so great an extent in the dates that are assigned to the creation of the world. The Julian period consists of 7980 years, and is considered to have commenced 4713 years before the Christian era. To express the date of any event happening before the Christian era in terms of the Julian period, subtract the date itself from 4714; but, to reduce any year A.D. to the corresponding date of the Julian period, add the date of the year to 4713. Thus, the year 1864 A.D. is the year (4713 + 1864) 6577 of the Julian period.

JULY, *ju-li'* (Lat. *Julius*), the name of the seventh month of the year. It formed the fifth month of the old Roman year, and was called *Quintilis* by the Romans; but shortly after the calendar had been rearranged by Julius Cæsar, the name Julius was given to this month by Marc Antony, in honour of Cæsar, whose birthday fell in it. It contains thirty-one days

JUMPERS, *jump'-erz*, the name given to a class of religious fanatics, from their practice of jumping during the time allotted for divine service. They arose in Wales in 1760, and several of the more zealous itinerant preachers encouraged the people to it. They were taught to cry out *gogoniant* (Welsh for glory), amen, &c.; then to put themselves in violent agitations; and, finally, to jump until they were quite exhausted, so as often to be obliged to fall down on the floor or the field where this kind of worship was held.

JUNCACEÆ, *jun-kai'-se-e* (Lat. *juncus*, a rush), in Bot., the Rush fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*,—sedge or grass-like herbs, with tufted or fibrous roots. The leaves are parallel-veined, either fistular or more or less flattened and grooved. The flowers are regular, usually glumaceous, or sometimes petaloid; perianth inferior, 6-parted, persistent; stamens 6 or 3, perigynous; anthers 2-celled, introrse; ovary superior, 1—3-celled, with single style, having 3 stigmas, or sometimes 1. The fruit is capsular, 3-valved, with loculicidal dehiscence, and with 1 or many seeds in each; rarely 1-celled, 1-seeded, and indehiscent; embryo very small, in horny or fleshy albumen. The *Juncaceæ* are found chiefly in cold and temperate climates, but a few inhabit tropical regions. [illegible] enumerates 19 genera and 200 species. The chief use to which the plants of this order are applied is in making floor mats, bottoms of chairs, &c. The pith from the fistular leaves of species of *Juncus* is used for the wicks of rushlights.

JUNCAGINACEÆ, *jun-ka-jin-ai'-se-e* (from Lat. *juncus*, a rush), in Bot., the Arrow-grass fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*, consisting of herbaceous marsh plants, found more or less in nearly all parts of the world, but most abundantly in temperate and cold regions. Leaves with parallel veins; flowers perfect, whitish or greenish; the perianth small, scaly, inferior, in two whorls, each consisting of 3 pieces; stamens 6; carpels 3—6, ovules 1—2. Fruit dry, separating into as many parts as there are carpels; seeds attached to axile or basal placentas, without albumen; embryo straight, with a lateral cleft.

JUNE, *june* (Lat. *Junius*), the name of the sixth month in the year, which was formerly the fourth among the Romans. It is supposed to have derived its name from the Latin *juniores*, young persons, as the preceding month of May was taken from *majores*, elders, or old persons. By some the month is said to be named after Juno, the wife and sister of Jupiter and queen of heaven. It consists of thirty days.

JUNGERMANNIACEÆ, *jun-ger-man-ne-ai'-se-e* (after the German botanist Jungermann), in Bot., the name given to a sub-ord. of the Diverworts or *Hepaticaceæ* (which *see*). They are usually called scale-mosses.

JUNGLE-FOWL, *jung'-gl* (Hindoo), or *Megapodius tumulus*, a species of birds belonging to the fam. of the *Megapodidæ* (large-footed), and its order *Gallinæ*, a fam. peculiar to Australia, where they were first discovered. The jungle-fowl is about the size of a common fowl, and the mounds which it rears for the purposes of incubation are said to be very large. In some instances they have been seen fifteen feet high, and are sixty feet in circumference at the base. Mr. Gould, in his description of the birds of Australia, says that it is almost exclusively confined to the dense thickets immediately adjacent to the Nathur, and that it appears never to go far inland. It is always met with in pairs, or quite solitary, and it feeds on roots, berries, and insects. The head and crest of the jungle-fowl are of a deep cinnamon-colour, while the back of the neck and all the under surface of the body are a very dark grey; the bill is a reddish-brown, and the tarsi and feet a bright orange.

JUNIPER. (*See* JUNIPERUS.)

JUNIPERUS, *ju-nip'-e-rus* (Lat.), in Bot., a gen. of plants belonging to the nat. ord. *Coniferæ*. The species *J. communis*, the common juniper, is a bushy shrub with evergreen sharp-pointed leaves. It grows in all the northern parts of Europe, in fertile or in barren soils, on hills or in valleys, on open sandy plains or in moist and close woods. In England it is generally found on open downs, in a chalky or sandy soil. In Scotland it is found on the hills and mountains, but not on the highest summits. In the south of Europe it is only found in elevated situations: it abounds in the Alpine region of Switzerland. All parts of the plant, when bruised, exhale a more or less agreeable terebinthinate odour. The fruits and young tops are used in medicine, having stimulant and diuretic properties. The volatile oil (oleum juniperi), obtained from the fruits and other parts by distillation with water, is officinal in our Pharmacopœias. The fruits or berries are used to flavour gin and Hollands. They are imported from the northern countries of Europe. Turpentine is frequently substituted for them in the preparation of English gin. Juniper-wood has a reddish colour, and is used occasionally for veneers. The species, *J. Oxycedrus* yields, by dry distillation, the tarry oil known in France as *huile de cade*: it is principally used in veterinary medicine. The timber of this species is very durable. *J. bermudiana* is the red or pencil cedar, and *J. virginiana* the Virginian red cedar. The wood of these species is used for pencils; that of the former is considered the best. *J. Sabina*, the common savin, is another interesting species: it is a native of the midland parts of Europe, and forms a small bushy shrub. The young branches, which are completely enveloped in the small imbricated leaves, are officinal in our Pharmacopœias. They, and the oil obtained from them, have acrid, stimulant, diuretic, emmenagogue properties. In large doses they are irritant poisons, and have been frequently taken to cause abortion. Savin ointment is a useful acrid application to keep open blistered surfaces.

JUNIUS, *ju'-ne-us*, is the name assumed by a political writer, whose letters appeared in Woodfall's "Public Advertiser" between 21st January, 1769, and 21st January, 1772. After their completion, they were published collectively, including those signed Philo-Junius, and those of Sir William Draper and Horne to Junius. Besides these (59 in all), there are 113 letters on various political subjects, and under different signatures, as Mnemon, Atticus, Lucius, Brutus, &c., which appeared in the "Public Advertiser" between 28th April, 1767, and 12th May, 1773, and which are attributed to the same hand. Some of these are of doubtful authenticity. There have also been preserved 62 brief business letters, addressed by him to Woodfall, between 20th April, 1769, and 19th January, 1773, and 10 letters written by him in private correspondence with John Wilkes, between 21st August and 9th November, 1771. The utmost period, therefore, in which

the agency of Junius can be traced, is less than six years, and the period within which he wrote his acknowledged letters exactly three years. The letters of Junius were directed against the ministry and the public characters connected with it, and excited the greatest public interest. The classic purity of their language, the exquisite force and perspicuity of their argument, their studied and epigrammatic sarcasm, dazzling metaphors, and fierce and haughty personal attacks, attained for them a popularity which no series of letters ever possessed, and arrested the attention of the government as well as the public. Not less startling was the intimate and minute knowledge which they evinced of court secrets, showing an intimate acquaintance not only with ministerial measures and intrigues, but with every domestic incident. Every effort was made by the government to discover the author of these letters, but in vain. "How comes this Junius," said Burke, "to have broke through the cobwebs of the law, and to range uncontrolled, unpunished, through the land?" "No sooner has he wounded one, than he lays down another dead at his feet. For my part, when I saw his attack upon the king, I own my blood ran cold. I thought he had ventured too far, and there was an end of his triumphs,—not that he had not asserted many truths." "But while I expected in this daring flight his final ruin and fall, behold him rising still higher, and coming down souse upon both houses of parliament. Yes, he did make you his quarry, and you still bleed from the wounds of his talons. You crouched and still crouch beneath his rage. Nor has he dreaded the terrors of your brow, Sir; he has attacked even you, he has; and I believe you have no reason to triumph in the encounter. In short, after carrying away our royal eagle in his pounces, and dashing him against a rock, he has laid you prostrate. Kings, lords, and commons, are but the sport of his fury." Who the author of these letters was, is as much matter of uncertainty now as it was then. Many volumes have been written on the subject, and nearly fifty have had their claims advocated to be considered that personage. Among these we may mention Sir Philip Francis, Edmund Burke, his brother William, Dr. Philip Francis, Earl Temple, Lord Chesterfield, George Grenville, Lord Sackville, James Grenville, Thomas Lord Lyttelton, Horace Walpole, John Horne Tooke, John Wilkes, Charles Lloyd, &c. Several of these persons laid claim to the honour of which they were ambitious. The strongest case appears to be made out in favour of Sir Philip Francis, though even here there are difficulties which it is hard to get over. The first attempt to fix the authorship upon Sir Philip Francis was made in 1816 by John Taylor, in his "Identity of Junius with a distinguished living Character established." The arguments are drawn principally from external considerations;—his absence on a journey to the continent coincides with an interruption to the letters; his departure for India, with a high appointment, with their cessation; his receiving that appointment without any apparent cause, just after being dismissed from the War-office; his station in the War-office, with all the details of which Junius is so familiar; his knowledge of speeches delivered in the House of Commons, reports of which had been furnished by Francis; coincidences of thought and expression between the letters and speeches of Sir Philip Francis and the letters of Junius, and certain peculiarities of spelling which were common to both; resemblance of the handwriting. More recently, various other points have been brought out in favour of Sir Philip Francis; so that, according to Macaulay, "the case against Francis, or, if you please, in favour of Francis, rests on coincidences sufficient to convict a murderer." One strong objection urged against Francis is, that he never before or after exhibited any proofs of a capacity or knowledge equal to the compositions of Junius, and that when the first letters were written he was only 27 years of age. It is further said, that Sir Philip Francis never directly denied his being the author; and Lady Francis affirmed that his first gift to her after marriage was a copy of "Junius;" and that he made a posthumous present to her of a sealed copy of Taylor's "Identity of Junius," found in his bureau. According to her, he made himself known as Junius to the king, Lord North, and Lord Chatham, under an engagement of secrecy, and received, in consequence, his Indian appointment. Mr. Henry G. Bohn, in his preface to the fifth part of his edition of "Lowndes' Bibliographer's Manual" (1859), attempts to throw some light on the author of these letters, or at least to point out where information was to be obtained. He states, that in July, 1850, he was called to value some political papers, manuscripts, and a library of books, at No. 3, St. James's Square, which had been the residence of the late earl of Holdernesse. He found a number of letters from the king, Sir William Draper, and a number of other political characters, to the earl of Holdernesse. In one of the drawers was a rough draft, in the well-known upright kind of writing of Junius, but corrected by another hand, of an unpublished letter by Lucius to the duke of Grafton. There were two large parcels set aside, sealed at every aperture, and marked on all sides "most secret;" and Mr. Bohn says, that he was "under a strong impression that the Junius correspondence was there." There is a correspondence in the *Athenæum* for the first half of 1860, between Mr. Bohn and Mr. Wright, in whose custody the papers then were, in which the latter denies several of the statements of Mr. Bohn. A new edition of the Letters of Junius, with his private letters to Mr. Woodfall, and an essay regarding the authorship, strengthening the claims of Sir Philip Francis, forms two of the volumes of "Bohn's Standard Library." The most complete bibliography of Junius is given in "Lowndes' Bibliographical Manual," edited by Bohn.

JUNK, *junk*, a flat-bottomed vessel, of about 100 or 150 tons burden, employed by the Chinese. Junks are built in the shape of a slipper, and carry three masts, and a short bowsprit placed on the starboard bow. The masts are supported by shrouds, and on the fore and main mast is a kind of bamboo lug-sail. The quaint shape in which these vessels are built is accounted for by the Chinese in the following manner:—Between two and three hundred years B.C., say they, the emperor, who had been for some time endeavouring to arrest the progress of navigation, in order to keep the "Celestial Land" free from the contamination of strangers, was one day thrown into a violent passion by a shipbuilder of southern China, who laid before him a perfect model of a sharp-keeled vessel, imploring his majesty to patronize his invention; but no sooner had he finished speaking, than the "heaven-descended monarch," grasping his slipper, threw it with unerring aim at the miscreant's head, at the same time crying, "Avaunt, monster! from henceforth build all thy vessels on the model of that old shoe."

JUNO, *ju'-no* (Lat. *Juno*), one of the asteroids, or planetoids, a group of small planets that revolve in orbits between those of Mars and Jupiter. (*See* ASTEROIDS.) It was discovered by a German astronomer, Herr Harding, of Lilienthal, on Sept. 1, 1804. It holds the third place among the asteroids in order of discovery, and the fourth in point of size, being 112 miles in diameter. Its mean distance from the sun is about 253,526,000 miles, and it accomplishes its revolution around that body in 4 years and 132 days.

JUNTA, *jun'-tă* (Span., an assembly), is a term applied in Spain to legislative assemblies or administrative councils. In the middle ages, the assemblies of the representatives of the nation without any preliminary call of the monarch were termed juntas. It was sometimes, also, used as synonymous with cortes. In 1808, Napoleon summoned together 150 representatives of the nation, under the name of junta, for the adoption of a constitution which he wished to establish. After the insurrection, a new junta was formed, composed of the principal leaders of the insurrection, and numbering forty-four members; besides which there was, in every province not subjugated by the French, a provincial junta subordinate to it. In English, the term junto (evidently of Spanish origin) is used to denote a cabal or faction.

JUPITER, *ju'-pit-er* (Lat. *Jupiter*), the sixth of the greater or primary planets, reckoning them in order from the sun, and including the planet Vulcan, which was discovered between Mercury and the sun in 1859. It is the largest of all the heavenly bodies in our solar system, with the exception of the sun itself. Its diameter is calculated to be about 90,750 miles, while its

mean density is about one-fourth of that of the earth, or 1·42 when compared with the density of an equal bulk of water represented ... The shape of the planet is that of an oblate ... its polar diameter, or the length of its axis of revolution, being 86,300 miles, which is, to its equatorial diameter, very nearly in the proportion of 16 to 17. The mean distance of Jupiter from the sun is calculated to be 494,000,000 miles; it accomplishes its revolution about its own axis in 9 hours 55 minutes, and its revolution round the sun in 11 years 317 days. The inclination of its orbit to the ecliptic is about 1° 19′, while the inclination of its equator to the ecliptic is 3° 5′ 30″. Cassini was the first who ascertained the length of the time in which Jupiter performs a complete revolution about its axis; but Hooke first discovered the fact of the actual rotation of the planet. When viewed through a telescope, the planet seems to be surrounded by several narrow bands or belts of a dark colour, which are parallel to each other and its equator. Astronomers differ as to the cause of this singular appearance; but it is supposed to arise from the presence of dense masses of cloud about the planet. Jupiter is accompanied by four satellites or moons, which revolve about it in the same manner as the moon revolves about the earth. The following table shows the approximate time of revolution of each satellite about the planet, with its distance from the planet and its diameter in miles:—

Satellites.	*Period of Rev.*		*Mean Dist.*	*Diam.*
	Day.	Hours.	Miles.	Miles.
1	1	18 166	272,250	2,440
2	3	13·233	435,600	2,180
3	7	3 716	694,250	3,560
4	16	16·533	1,223,125	3,045

All the satellites, with the exception of the fourth, suffer an eclipse in each revolution round the planet. The eclipses of the satellites of Jupiter, especially of the first, afford the means of determining the longitude of any place on the earth's surface, and the time at which any eclipse of Jupiter's satellites commences is consequently registered in the "Nautical Almanac" for the guidance of sailors, the time named therein being the hour at which the eclipse would commence at Greenwich, if visible there. Now at whatever parts of the earth these eclipses are visible, they are always seen by observers at exactly the same moment of time, in consequence of the great distance of Jupiter from the earth. The observer, wherever he may be, has merely to note the exact time at which the eclipse commences when viewed from his position, and then refer to the "Nautical Almanac" to ascertain the time at which it commences at Greenwich. The difference between the times when reduced to degrees and minutes, an hour of time corresponding to 15 degrees of space, will show the longitude of the observer's position, which will be east of Greenwich if the time at which he observes the commencement of the eclipse be later than at Greenwich, and west of that place if it be earlier. Thus, if the commencement of the eclipse of a satellite of Jupiter be 8 p.m. according to Greenwich time, the time of immersion to an observer 15° E. of Greenwich, will be 9 p.m., and to an observer 15° W. of that place it will be 7 p.m.

Jurassic Formation. (*See* Oolitic System.)

Jurisconsult, *ju-ris-kon'-sult* (Lat. *juris-consultus*, learned or skilled in law), is one who gives his opinion on cases of law, a master of the Roman jurisprudence. Among the Romans, the juris-consulti were men who studied the forms and principles of law, and gave opinions upon difficult points.

Jurisdiction, *ju-ris-dik'-shun*, in Law, is derived from the Latin word *jurisdictio*, signifying the declaration of law, and was used by the ancients to denote the administration of justice, as well as the right to administer justice. It is now commonly used to denote legal authority. The courts of Westminster have jurisdiction over the whole of England and Wales; the jurisdiction of the other courts is limited to certain districts and certain kinds of causes. Where a party is convicted by a court or judges who exceed their jurisdiction, the matter may be removed to the court of Queen's Bench by writ of certiorari, and the proceedings quashed. A court is not to be presumed to have jurisdiction where it does not appear to have one.

Jurisprudence, *ju-ris-proo'-dens* (Lat. *jurisprudentia*), is the science of right, or of positive law. It is divided into general and particular. The former is the science or philosophy of positive law, and investigates the principles which are common to all positive systems, apart from the local, partial, and accidental circumstances and peculiarities by which these systems respectively are distinguished from one another. Particular jurisprudence treats of the laws of particular states; which laws are, or at least profess to be, the rules and principles of universal jurisprudence itself specifically developed and applied. (*See* Law.)

Jury, *ju'-re* (Lat. *jurata*, from *juro*, I swear), in Law, is a number of men duly authorized to inquire into or determine certain facts, and bound by oath to a faithful discharge of their duty. The time when trial by jury was instituted in this country is matter of much dispute, as well as whether it is of Anglo-Saxon or of Norman origin. It was, however, not till the reign of Henry II. that this institution became fully established and was reduced to a regular system. It was then made a mode of deciding facts in real actions, which a subject might claim as a matter of right. It is worthy of remark, that until about the reign of Henry VI., trial by jury was in reality a trial by witnesses; and hence they were sworn—not "to give a true verdict, according to the evidence," but merely "to speak the truth." Inquiry into matters on behalf of the crown, by means of juries, was frequent in England long before trial by jury was commonly in use in courts of justice. At present, a jury is composed of twelve men, sworn to decide facts according to the evidence brought before them, either in civil or criminal matters. The three kinds of juries in the ordinary courts of justice in England, are the grand juries, the petty or common juries, and special juries. Grand juries are exclusively connected with criminal jurisdiction. (*See* Grand Jury.) By act 6 & 7 Geo. IV. c. 50, a juror must be twenty-one years of age, and if above sixty, he is exempted, but not disqualified, from serving. He must also possess freehold or copyhold property of the clear yearly value of ten pounds, or have leasehold property, held by lease for twenty-one years or longer, of the annual value of twenty pounds, or occupy a house containing not less than fifteen windows. In London, the occupation of a house, shop, or place of business within the City, or the possession of real or personal property of the value of one hundred pounds, constitutes a qualification. There are certain classes of persons exempt from serving on juries; namely, judges, clergymen in holy orders, Roman Catholic priests and dissenting ministers, serjeants, barristers and advocates, attorneys and proctors, officers of courts, coroners, gaolers, &c.; physicians, surgeons, and apothecaries, officers in the army or navy, pilots and masters of vessels, officers of customs and excise, the household servants of the sovereign, sheriffs' officers, constables, and parish clerks, and the like. Lists of persons qualified to act as jurors are made out annually by the churchwardens and overseers of each parish. Copies of this list are fixed on the church doors on the three first Sundays in September; objections are heard, and the lists allowed and signed by the justices of the peace, at a special petty sessions held for that purpose within the last seven days of the same month. The functions and duties of the high constables are repealed by 26 & 27 Vict. c. 107 (1862); and now, the clerk to the justices, as soon as the lists have been approved of and signed, has to forward them by post to the clerk of the peace for the county, who causes them to be copied into a book, which he has to deliver to the sheriff. This book is used for the following year, commencing on the 1st day of January. From the list received from the clerk of the peace, the sheriff takes the names of all those persons who are described as esquires, or persons of higher degree, as bankers or merchants, which are copied out in a separate list, called the "special jurors' list," from which special jurors are to be summoned when required. In an ordinary trial by jury in civil cases, when an issue is joined, the court awards a *venire facias* upon the roll or record, in these words,—"Therefore let a jury come, &c.;" and the jurors are summoned by the sheriff, in virtue of a precept issued to him for that purpose. By 25 & 26 Vict. c. 107, all persons liable to

serve may be summoned by post, the sheriff, or other proper officer, affixing his seal to the letter, which is to be addressed "Jury summons," and directed to his place of abode as given in the jurors' book. In this case two additional days are allowed, beyond the number required by law for the service of a summons, before the day on which the juror is required to attend. The panel is open to inspection in the sheriff's office for seven days before the trial, whereby the parties may have notice of the jurors, and of their sufficiency or insufficiency, characters, connections, and relations: so that they may be challenged upon just cause. The sheriff returns his execution of the precept issued to him to summon jurors, with the panel of jurors annexed, to the judge's officer in court, when the cause comes on for trial. The jurors contained in the panel are either common or special. Special juries were originally introduced in trials at bar, when the causes were of too great nicety for the discussion of ordinary freeholders. Either party is entitled to have a special jury for the trial of any issue, as well at the assizes as at bar; he paying the extraordinary expense, unless the judge will certify that the cause required such special jury. When a special jury is to be summoned, forty-eight names are taken by ballot from the special jurors' list, in the manner particularly described in the statute; and from this number twelve are then struck off by each party, and the names of the remaining twenty-four are the jurors to be summoned for the cause, the first twelve of whom that answer to their names constituting the special jury. The names of the jurors being written on tickets, are put into a box or glass; and when each cause is tried, twelve of those persons whose names shall be first drawn out of the box shall be sworn upon the jury, unless absent, challenged, or excused. Challenges are of two sorts,—challenges to the array and challenges to the polls. Challenges to the array are at once an exception to the whole panel in which the jury are arrayed or set forth by the sheriff in his return, as [illegible] account of some default in the sheriff, or his under-officer who arrayed the panel. [illegible] *capita*, are exceptions to [illegible] and are reduced to four heads:—1. *Propter honoris respectum*, as if a lord of parliament be impanelled on a jury; 2. *propter defectum*, as where one has not an estate sufficient to qualify him to be a juror; 3 *propter affectum*, from being suspected of bias or partiality in the cause; 4. *propter delictum*, [illegible] crime or misdemeanour that affects the juror's credit and renders him infamous. If, by means of challenges or other cause, a sufficient number of unexceptionable jurors do not appear at the trial, either party may pray a *tales*, that is, a supply of such men as are summoned upon the first panel, in order to make up the deficiency. If any man summoned to attend on a jury shall not attend in pursuance of such summons, or, being thrice called, shall not answer to his name; or if any such man, or any talesman, after being called, shall not appear, or withdraw himself from the presence of the court, the court shall set such fine upon him as it may see fit, and in the case of a viewer, not less than £10. When a sufficient number of persons impanelled, or talesmen, appear, they are then separately sworn well and truly to try the issue between the parties, and to give a true verdict, according to the evidence. The jury are [illegible] ready to hear the merits, and the pleadings are opened to them by counsel, on that side which holds the affirmative of the question in issue. The evidence on the same side is next gone through, and summed up if necessary, after which the advocate on the other side opens the adverse case, and supports it by evidence, and sums up if necessary; and then the party which began is heard in reply. The judge then sums up the whole of the evidence to the jury, omitting all superfluous circumstances, observing wherein the main question and principal issue lies, stating what evidence has been given in support of it, with such remarks as he thinks necessary for their direction, and giving them his opinion in matters of law arising upon that evidence. The jury then, unless the case be very clear, withdraw from the bar to consider their verdict; and, in order to avoid intemperance or undue delay, they are kept without meat, drink, fire, or candle, unless by permission of the judge, till they are unanimously agreed. When they are unanimously agreed, they return back to the bar, and before they deliver their verdict, the plaintiff is bound to appear in court by himself, attorney, or counsel, according to the old form, to answer the amercement to which he was liable if he failed in his suit. It is usual for a plaintiff, when he perceives that he has not given evidence sufficient to support his issue, to withdraw himself, and thus be nonsuited; in which case no verdict can be given, and he may commence the same suit again for the same cause of action; but if a verdict has been delivered thereon, he is for ever barred from proceeding upon the same ground of complaint. In case the plaintiff appears, the jury, by their foreman, deliver in their verdict, which is recorded in court, and they are then discharged. These remarks regarding juries in civil causes apply for the most part also to juries in criminal suits. The qualifications, disqualifications, and exemptions, are the same in both cases. When a prisoner, on his arraignment, has pleaded not guilty, and has put himself for trial upon the country,—that is, the jury, the sheriff of the county must return a panel of jurors for that purpose. If the proceedings are before the court of Queen's Bench, the trial in case of a misdemeanour is had at *nisi prius*, unless it be of such consequence as to merit a trial at bar; but in either case a special jury may be obtained on the motion of either the prosecutor or the defendant. When the trial is called on, the jurors are sworn as they appear, to the number of twelve, unless challenged by either party. Challenges may be made either on the part of the queen or the prisoner, and may be either to the whole array or to separate polls, as in civil causes. Besides the four kinds of causes on account of which a juror may be challenged in civil cases, there is, in criminal cases, or at least in capital ones (and in legal phraseology all felonies are capital), allowed to the prisoner an arbitrary and capricious species of challenge to a certain number of jurors, without showing any cause at all, which is called a peremptory challenge. The number of jurors that may thus be peremptorily challenged is fixed at twenty in felonies and thirty-five in treason. Where an alien is indicted or impeached of any felony or misdemeanour, he has the right of craving to be tried by a jury *de medietate linguæ*, or half foreigners; and the sheriff, or proper minister, shall return for one half of the jury a competent number of aliens, if so many are to be found in the place where the trial is had, and if not, then as many aliens as shall be found. No such alien juror is liable to be challenged for want of freehold or other qualification, but may be challenged for any other cause. When the number of jurors is deficient, talesmen may be awarded, as in civil causes. Formerly, if the verdict of the jury were notoriously wrong, they might have been punished, and their lands and chattels [illegible] to the king, and their verdict might have been set aside by attaint, at the suit of the king, although not at the suit of the prisoner; but this mode of punishment is abolished, fine and imprisonment being substituted in lieu thereof after indictment or information. The practice formerly in use of fining, imprisoning, or otherwise punishing, merely at the discretion of the court, because their verdict was contrary to the direction of the judge, was [illegible], unconstitutional, and illegal. If the jury find the prisoner not guilty, he is then for ever quit and discharged of the accusation; but if guilty, he is then [illegible] to be convicted of the crime whereof he stands indicted.—(*Ref.* Forsyth's *History of Trial by Jury*; Kerr's *Comment on the Laws of England*.) In Scotland, in criminal cases, the number of the jury is fifteen, and the *majority* of that number give the [illegible]dict; and in civil causes the number of the jury is twelve, and they must be unanimous, as in England; but it is provided, that if, after three hours' deliberation in any civil cause in the Court of Session, nine of said jury shall agree, their verdict shall be taken.

JURY-MAST, a temporary [illegible] erected in a ship in the place of one that has been lost either in action or by storm. A *jury-mast* [illegible] sometimes erected in [illegible] newly-built vessel to navigate her down the river or to a neighbouring port, where her proper masts are awaiting her.

JUS, *jus* (Lat.), is a word borrowed from the Latin language, and very frequently used in law and other-

wise. It admits of several significations, the chief of which are,—that which is right or conformable to law; also the obligation which the law imposes; also a man's privileges, whether singularly or collectively: it means likewise the power which originates from the law, as well as the place where justice is administered.

JUS DIVINUM. (*See* DIVINE RIGHT.)

JUS MARITI is the term applied in Scots law to the uncontrolled power of administration of the goods in communion vested in the husband, by which he acquires an unlimited right of management and disposal of the movable estate of the wife, whether belonging to her at the time of the marriage or acquired during its subsistence.

JUS QUIRITIUM signified the fullest enjoyment of a Roman citizen of the right of security of personal liberty, of registration on the list of property, of participation in the service of the legion, in public honours, of the right of suffrage, &c.

JUSTICE, *jus'-tis* (Lat. *justitia*), is one of the four cardinal virtues, and was regarded by Plato as including all human virtue or duty. It is the doing what is just or right, and may be distinguished as ethical, economical, and political. The first consists in doing justice between man and man, as men, as members of the same human family; the second, in doing justice between the members of a family or household; and the third in doing justice between the members of a community or commonwealth. Justice, as opposed to equity, means merely doing what positive law requires, while equity is doing what is fair and right in the circumstances of each particular case. Justice is not founded in law, as some assert, but in our idea of what is right; and laws are just or unjust just in so far as they do, or do not, conform to that idea.

JUSTICE CLERK, THE LORD, OF SCOTLAND, was originally the clerk and assessor of the justiciary, and was first assumed as a judge in 1663 and confirmed in 1671, when the court was remodelled. He was soon after raised to the dignity of second president of the Justiciary court, and is the presiding judge in that court in the absence of the lord justice-general. He is always one of the lords of the Court of Session, and on the division of that court into two chambers in 1811, he was made *ex officio* president of the second division. The office of lord justice clerk is now, in point of rank, the second judicial appointment in Scotland. He is one of the officers of state for Scotland, and one of the commissioners for keeping the Scottish regalia.

JUSTICE-GENERAL, THE LORD, OF SCOTLAND, was the president or head of the court of Justiciary, and was formerly an officer of high rank and consideration. For many years it had become a sinecure, being usually held by some of the Scottish nobility, while the duties of the office were discharged by the lord justice clerk; so that at length, by 1 Wm. IV. c. 69, the office was declared to be abolished on the termination of the then existing interest, and the duties to devolve upon the lord president of the Court of Session, with which office they were afterwards to remain conjoined.

JUSTICES OF THE PEACE are persons appointed by royal commission to keep the peace within a certain district. The queen is, by virtue of her office and dignity, the principal conservator of the peace within her dominions, and may give authority to any other to see the peace kept, and to punish such as break it. All the judges of the superior courts are conservators of the peace, and are sometimes called justices; but justices of the peace, commonly so called, are persons appointed by the queen's special commission under the great seal, the form of which was settled by all the judges in 1590, and continues, with little alteration, to this day. This commission appoints them all, jointly and severally, to keep the peace in the particular county named, and to cause to be kept all the ordinances and statutes for the preservation of the same; and to chastise and punish all persons that offend against the same. Any two or more of them (in which number some particular justices, or one of them, are always to be included) are also authorized to inquire into and determine felonies and other misdemeanours committed in said county, and to chastise and punish the said offenders, and every one of them, for their offences, by fines, ransoms, amerciaments, forfeitures, and other means, as according to law. When any justice named in the commission intends to act under it, he sues out a writ of *dedimus potestatem* from the clerk of the crown in chancery, empowering certain persons therein named to administer the usual oaths to him; *i.e.*, an oath of qualification as to estate, to which are added the oaths of allegiance, supremacy, and abjuration, which being done, he is at liberty to act. By 18 Geo. III. c. 20, every justice of the peace for any county, riding, or division within England or Wales, is required to have, in law or equity, in possession and for his own use and benefit, a freehold, copyhold, or customary estate for life, or for some greater estate, or an estate for some long term of years determinable upon life or lives, or for a certain term originally created for twenty-one years or more, in lands, tenements, or hereditaments in England or Wales, of the clear yearly value of £100 over and above all incumbrances affecting, and all rents and charges payable out of or in respect of, the same, or shall be seised of, or entitled to, in law or equity, for his own use and benefit, the immediate reversion or remainder of and in lands, tenements, and hereditaments leased for one, two, or three lives, or for any term of years determinable on lives upon reserved rents, and which are of the yearly value of £300. Certain official persons are excepted from these provisions. By 6 & 7 Vict. c. 73, no attorney or solicitor shall be capable of being a justice of the peace for any county during such time as he practises as an attorney or solicitor. The office of justice of the peace subsists during the pleasure of the crown, and is determinable either directly by writ under the great seal, or indirectly by a new commission from which his name is omitted. The commission is also determined by the death of the sovereign by whom it was issued. No action can be brought against a justice of the peace for any act done by him in the execution of his duty with respect to any matter within his jurisdiction, however erroneous his decision may be, unless it be proved that the act was done maliciously and without reasonable or probable cause; and in such a case he is answerable to the court of Queen's Bench, which exercises a general superintendence over the conduct of those to whom the administration of criminal justice in the country is committed. The court will not take up the question whether the proceeding was right or not in itself, but solely whether it proceeded from unjust, corrupt, or oppressive motives. The powers and duties of a justice of the peace are laid down in his commission, and in various statutes. Act 5 & 6 Vict. c. 38, defines the jurisdiction of justices at quarter sessions, and acts 11 & 12 Vict. cc. 42 and 43, define the duties of justices out of sessions.

JUSTICIAR OF SCOTLAND, *jus-tish'-e-ăr*, was the ancient criminal judge in Scotland, an officer of great power and authority, being at the head both of the law and the military force of the kingdom. About 1526, the office became hereditary in the noble family of Argyll, in whose hands it continued for upwards of a century, and afterwards became merged in that of justice-general.

JUSTICIARY, CHIEF, OF ENGLAND.—This office is traced back to that of grand seneschal, or dapifer, of the early Franks. The seneschal was originally a sort of steward of the household of the Frank kings, who, after their conquest of Gaul, rose to be the highest officer of the state, after the king, and acted as his representative in all the departments of the state. In England, the office was divided into two parts, having two distinct officers, the one the chief justiciary, to whom the judicial affairs of the state were committed, and the other the chief officer of the royal household. The authority of the chief justiciary extended over every court in the kingdom; he presided not only in the king's court and in the exchequer, but when the office of the lord high steward fell into abeyance, he was regent of the kingdom during the king's absence, and writs ran in his name. The power of the chief justiciary was broken towards the end of the Norman period, and the *Aula Regis*, in which he presided, was divided into four distinct courts; viz., Chancery, Exchequer, King's Bench, and Common Pleas. It determined about the 45 Hen. III.—Ref. *English Cyclopædia*—Arts and Sciences.

JUSTICIARY, HIGH COURT OF, is the supreme criminal court of Scotland, composed of five lords of the

Court of Session, added to the lords justice-general and justice clerk. Its constitution was settled by act 1672, c. 16. It sits from time to time in Edinburgh, during the year, according to the amount of business to be transacted; besides which, the lords of justiciary are directed to hold circuit courts regularly twice a year, in spring and autumn, in different parts of the country. There are three circuits: the South, consisting of the burghs of Jedburgh, Dumfries, and Ayr; the West, consisting of Glasgow, Inverary, and Stirling; and the North, consisting of Perth, Aberdeen, and Inverness. Besides which, a winter circuit court is held in Glasgow. Each circuit court is attended by two judges; but in Glasgow they may sit separately in different courts. The jurisdiction of this court extends to all crimes, and includes the whole of Scotland; and it has also the power of reviewing the sentences of all inferior criminal courts in Scotland. From its decisions there is no appeal, either to the House of Lords or any other house. The Circuit Court has also a civil jurisdiction as a court of appeal. The cases are tried by a jury of fifteen, who do not require to be unanimous, as in England, the verdict being according to the opinion of the majority.

Justifiable Homicide. (*See* Homicide.)

Justification, *jus-tif-e-kai'-shun* (Lat. *justus*, just, and *facio*, I make), denotes a judicial act,—the declaring or pronouncing a person just or righteous according to law. It is used either in a legal or theological sense. Where a person is found not to have broken the law, he is said to be justified in a legal sense. But in this way none of the human race can be said to be justified or stand acquitted before God; for we are told that there is none righteous; no, not one. The justification, therefore, of which the Scriptures principally treat, is not a personal, but an imputed righteousness. It is through the righteousness of Christ, the spotless obedience, bitter sufferings, and accursed death of the son of man, who became surety for him, that the sinner is justified before God. Justification, according to the Assembly's catechism, "is an act of God's free grace, whereby he pardoneth all our sins, and accepteth us as righteous in his sight, only for the righteousness of Christ, imputed to us, and received by faith alone." "Justification," says Bishop Hopkins, "is a gracious act of God, whereby, through the righteousness of Christ's satisfaction imputed, he freely remits to the believing sinner the guilt and punishment of his sins; and through the righteousness of Christ's perfect obedience imputed, he accounts him righteous, and accepts him into love and favour, and unto eternal life. This is justification, which is the very sum and faith of the whole gospel, and the only end of the covenant of grace." Justification is (1) an act of God's free grace, without any merit whatever in the creature; (2) it is an act of justice, as well as of grace,—the law being perfectly fulfilled in Christ, and divine justice satisfied; (3) it is an individual, an instantaneous act, done at once, and admitting of no degrees; and (4) it is irreversible, and an unalterable act. The effects or blessings of justification are—(1) peace with God; (2) access to God through Christ; (3) acceptance with God; (4) peace of conscience, and a holy confidence and security under all the difficulties and securities of the present state; and (5) finally, eternal salvation.

Justinian's Code, or **Legislation**, *jus-tin'-e-ăns*, is the name given to the code of laws drawn up by order of the Roman emperor Justinian, soon after he ascended the throne. His object was to establish a complete system of written legislation for all his dominions; and to this end to make two great collections,—one of the imperial constitutions, or the best and most useful laws of his predecessors from the time of Hadrian; the other of all that was valuable in the works of the jurists. In A.D. 528, he named a commission, consisting of Joannes and nine other persons, to compile the preceding constitutions, with ample powers to correct and retrench, as well as to consolidate and arrange. Partial compilations had previously been made, as by Gregory and Hermogenes, in the reign of Constantine, and the Theodosian code effected under Theodosius II. The commission executed their task speedily; and on the 7th of April, A.D. 529, it received the imperial sanction. At the end of the following year, Tribonian, who was one of the previous commission, and had given great proofs of ability, was authorised to select fellow-labourers to assist in the other and more difficult part of the undertaking. He selected sixteen coadjutors, and they set to work with such earnestness that their task was completed in little more than three years, and received the imperial sanction on 30th December, 533. The compilation, termed "Digests," or "Pandectæ," from its comprehensive character, was divided into fifty books, and arranged on the model of the Perpetual Edict. It comprehends upwards of 9,000 extracts, in the selection of which the compilers made use of nearly 2,000 different books, containing more than 3,000,000 lines. Justinian wished that his body of laws should supersede all others, both for practice and for study; but the Digest and Code led too far into details, and could not be well understood by beginners; hence the necessity for having an elementary work composed for that purpose. Already, in the constitution of December, 530, Justinian had declared his intention of having an elementary work composed. Its preparation was intrusted to Tribonian, in conjunction with Theophilus and Dorotheus; and it received the imperial sanction 21st November, 533. This elementary work is the Institutes, and is divided into four books, being formed on the basis of the Institutes of Gaius, but altered so as to harmonize with the Digest and Code. There were still some points which had been debated by the old jurists; and, at the suggestion of Tribonian, the emperor began, while the compilations were yet in progress, to issue constitutions, having for their object the decision of these controverted points. These were collected and published, to the number of fifty, and formed what is known as the "Fifty Decisions." As the code of 529 was a very imperfect work, it was determined to revise it, and to incorporate the "Fifty Decisions" in the revised edition. The work was committed to Tribonian, with four others, and received the imperial sanction on the 16th November, 534. This, the "Codex Repetitæ Prælectionis," is the code which we now have, the earlier one having bee carefully suppressed, and no trace of it remaining. It is divided into twelve books, and the books into titles, with rubrics denoting their contents. Under each title the contents are arranged chronologically. The arrangement in general corresponds with that of the Digest. Justinian, however, was not content with being a collector, he must also be a maker of law. He could not see that his having systematized the law should exclude him from law-making. He announced in the Code, that any legislative reforms he might at any future time see fit to make should be published in the form of "Novellæ Constitutiones" Many such novellæ were afterwards published,—the first in January, 535; the last in November, 564. Altogether, they amount to 165, though but few of them bear a later date than 546, the year of Tribonian's death. No collection seems to have been made of them during the lifetime of Justinian. These works of Justinian, notwithstanding their defects and faults, are deserving of very great praise. They have exercised an incalculable influence over the thoughts and actions of men, and are to be found pervading most of the systems of law of the civilized world. The "Digest" is especially valuable, as preserving remains of the works of jurists which would otherwise have been lost, and which are of great value as illustrating the history of these times, and affording models of legal reasoning and expression.—*Ref.* Smith's *Dictionary of Ancient Biography*, art. *Justinianus*; *English Cyclopædia*—Arts and Sciences; *The Institutes of Justinian*, by T. C. Sandars, 1853.

Jute. (*See* Corchorus.)

Juvenile Offenders, *ju'-ve-nile* (Lat. *juvenis*, young).—A number of statutes have of late years been passed regarding the reformatory treatment of juvenile criminals. By 17 & 18 Vict. c. 86, any person under sixteen years of age who shall be convicted of any offence before a magistrate, or two or more justices of the peace in England, or any sheriff, or magistrate of burgh, or police magistrate, in Scotland, may, in addition to the sentence passed as punishment, be sent to a reformatory school, to be detained for a period of not less than two or more than five years: there must, however, be a previous imprisonment of not less than fourteen days The Treasury is to defray the whole or a portion of the cost of the care and

maintenance of such offender, at such a rate per heau as shall be determined on. The court may, however, compel the parent, or step-parent, to support such offender, if of sufficient ability to do so. The offender absconding from school, or wilfully neglecting or refusing to abide by the rules thereof, may be punished by the foresaid magistrates by imprisonment with hard labour, for any period not exceeding three months.

JYAR, *ji'-ar*, is the name of the eighth month of the Jewish year, corresponding, at the earliest, with our April; but it may be as late as May. It has only 29 days.

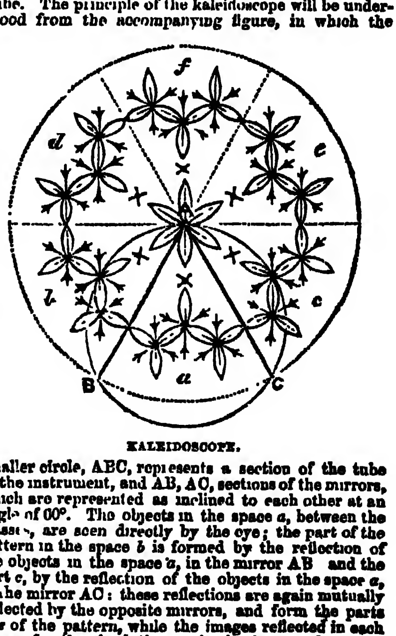
K.

K, *kai*, is the eleventh letter and eighth consonant in our language. Its sound is that of *c* before the vowels *a*, *o*, *u*, and the two are sometimes interchangeable; as in German, *carl* or *karl*; Latin *kalendæ* or *calendæ*. K was borrowed from the Greek *kappa*, or the Oriental *kaph*, and finds only an ambiguous place in occidental languages. Sallust, a Roman grammarian, attributes its introduction into the Latin to one Salvius; and Priscian looked upon it as a superfluous letter, and says that it was never used but in words derived from the Greek. Quintilian denies it a place in the Latin, and blames its use even in such words as *kalendæ*, *kalumnia*. According to Scaurus, *k* was anciently used instead of the syllable *ca*, *c* instead of *ce*, *ci*; and it is owing to this ancient usage that, in our modern alphabets, *k* is pronounced *ka*, and *c*, *ce* and *ci*. K alternates, in the Semitic languages, with *g*, *t*, *q*, *h*, *kh*, *ghain*; and in the Indo-European with those letters and with *c*, *j*, *y*, *w*. In English, *k* is for the most part used only before *e*, *i*, and *n*, in the beginning of words, as *ken*, *kill*, *know*, and the like. Formerly it used to be joined with *c* at the end of words, as in *publick*, *musick*; but it is now omitted except in words of one syllable, as *jack*, *block*. Among the Romans, slanderers used to be branded on the forehead with *k* (*kalumnia*). As a numeral, K denotes 250; with a stroke over it, thus—K̄, 250,000.

KAABA, *ka'-a-ba*, is the name of a famous mosque in the city of Mecca, and the object of as much veneration to Mohammedans as the Holy Sepulchre was to Roman Catholics. It is an oblong edifice of fine grey granite, standing in the centre of a large open court; and is, according to Burton, 55 feet in length by 45 in breadth. It is surrounded by a covering of black silk, hanging down from the roof, with a golden band running round the top, and a golden curtain in front of the door. The door, by which free admission is granted only ten or twelve times in the year, is in the north-west side, about seven feet from the ground, and is covered with silver and adorned with ornaments of gold. The entrance is gained by a flight of steps of carved wood, which is moved away on rollers when not used. The interior is plain, and destitute of windows, or any other opening besides the entrance, except a small door, called the *Bab el Taubah*, or Gate of Repentance, leading to a staircase by which access is gained to the roof. The floor and walls consist of a sort of chequer-work of marble, of various colours, principally white, and the roof and top part of the walls are covered with red damask embroidered with gold. The *Hajar el Aswad*, or black stone, which is the object of so much adoration on the part of pilgrims, stands at the east corner of the building, at the height of four or five feet from the ground, and is composed of a number of small stones, cemented together, and carefully smoothed, having the appearance of having been broken in pieces and then mended. The constant wear which it has undergone at the lips and hands of worshippers renders it extremely difficult to determine the nature of the material, but most travellers regard it as of volcanic origin, and, according to Burton, it is a large aerolite. On the outside, in the south-west wall, is a stone of a dark-red colour, which is also touched and kissed by the devotees. On the north-west side of the Kaaba are situated what are said to be the graves of Ishmael and Hagar, inclosed by a semicircular wall five feet high and four feet thick, covered with white marble. The *Zem-Zem*, or sacred well, said to be that of Hagar, is inclosed in a square, substantial building, opposite the east corner of the Kaaba.

KAKODYL. (*See* CACODYL.)

KALEIDOSCOPE, *kăl-i'-dos-kope* (Gr. *kalos*, beautiful; *eidos*, form, and *skopeo*, view or sight), an optical toy, which was suggested by Baptista Porta and Kircher, but invented and perfected by Sir David Brewster. By a peculiar arrangement of mirrors, or reflecting surfaces, it produces the appearance of a perfectly symmetrical pattern, which undergoes an endless variety of changes, by turning the tube in which the mirrors are fixed. It is chiefly useful in furnishing ideas to designers of patterns for paper-hangings, carpets, &c., and any woven or printed fabric, in which symmetry of design is desirable. The simplest form of kaleidoscope consists of a cylinder of tin, in which two plane rectangular mirrors of polished metal, or of glass, having the back blackened, are fixed at such an angle of inclination to each other as may be obtained by dividing 360° by the numbers 3, 4, 5, 6, 7, 8, &c. The cylinder is covered at one end with a circular plate of metal, having a small hole in the centre, while a rim of metal is fitted over the other end, which is so constructed that two circular pieces of glass may be fixed in it, at a short distance from each other, having some pieces of coloured glass, beads, lace, feathers, &c., in the space between them. The piece of glass that is placed at the extreme end of the cylinder should be ground glass, so that while the light is admitted into the interior of the instrument, external objects may be prevented from becoming perceptible to the observer. An angle of 60° is perhaps the best angle of inclination for the mirrors, as it may be readily determined, and affords a six-fold repetition of the pattern, which presents a tolerably uniform appearance of colour in all parts. If the angle of inclination be greater than 60°, the pattern will not be multiplied to so great an extent; but if less, although the pattern will be re[illegible] times, it will lose consider[illegible] towards the part where the reflections of the mirrors meet, by the frequency of the multiplication. In some kaleidoscopes, the mirrors are made trapezoidal in form, instead of rectangular, the broader ends being placed at the lower end of the tube. The principle of the kaleidoscope will be understood from the accompanying figure, in which the



KALEIDOSCOPE.

smaller circle, ABC, represents a section of the tube of the instrument, and AB, AC, sections of the mirrors, which are represented as inclined to each other at an angle of 60°. The objects in the space *a*, between the glasses, are seen directly by the eye; the part of the pattern in the space *b* is formed by the reflection of the objects in the space *a*, in the mirror AB and the part *c*, by the reflection of the objects in the space *a*, in the mirror AC: these reflections are again mutually reflected by the opposite mirrors, and form the parts *d*, *e* of the pattern, while the images reflected in each mirror for the third time unite in the part *f*, so as to

form a corresponding appearance to the other parts. It is manifest, that unless the angle at which the mirrors are inclined be accurately determined, the reflections will not coincide, and the pattern will not be complete in the part *f*. Kaleidoscopes are made in which the angle of incidence of the mirrors may be varied at pleasure, and by the aid of a lamp and a system of lenses in connection with the instrument, the pattern may be projected on a screen, in an enlarged form, like the image thrown from a slide in a magic lantern. A pleasing effect of a similar nature, in which the images of the original object are multiplied, and produced in different directions, may be produced by fitting the edges of three, four, or six trapezoidal mirrors together, so as to form a hollow prism, and putting them into a tube, similar to that in which the two mirrors of the ordinary kaleidoscope are inserted. Instruments of this kind, which were invented by Dr. Roget, are called polycentral kaleidoscopes. An instrument resembling the kaleidoscope in its general principles, to which the name of debuscope has been given, was invented in Paris in 1860. It is used for forming patterns for calico-printing.—*Ref.* Brewster's *Treatise on the Kaleidoscope;* Lardner's *Museum of Science and Art; Annals of Philosophy*, vol. xi.

KALENDAR. (*See* CALENDAR.)

KALENDS. (*See* CALENDS.)

KALMIA, *kăl'-me-ă* (so named in honour of Peter Kalm, the Swedish traveller), in Bot., a gen. of plants belonging to the nat. ord. *Ericaceæ*. The species are beautiful shrubs, and belong to the class of ornamental plants commonly called American. At the horticultural shows they are always exhibited with rhododendrons and azaleas.

KAMALA. (*See* ROTTLERA.)

KAMI (*ka'-me*), a name given in Japan to certain spirits or divinities, the belief in which seems to have characterized the ancient religion of that country, before it became intermingled with foreign doctrines, and still constitutes its basis. The kami are believed to be partly elemental, subordinate to the deities of the sun and moon, and partly the spirits of men,—in fact, every natural agent and phenomenon is supposed to have its own spirit or genius. The spirits of human beings survive the body, and, according to the actions of the individual in life, receive reward or punishment. When a man's life has been distinguished for its piety, or for the good he has done to his fellow-men, after death he is deified, and his *kami* is worshipped. The number of these kami at the present day is estimated at 3,000, and they are worshipped in temples without statues or images. Each kami is represented by a mirror, as the emblem of purity; and all the rites and ceremonies seem to be typical of purification. The priests who superintend the worship of these temples are called kami-nusi, or the ministers of the spirits.

KAMPTULICON, *kămp-tu'-le-kon* (from Gr. *kamptos*, flexible, and *tule*, a coverlet), a species of floor-covering which has, of late years, superseded oil-cloth and other similar substances. It was first patented by the Messrs. Goodyear, which firm exhibited the first specimen of kamptulicon in the Great Exhibition of 1851. It is manufactured by combining cotton, cork, wool, and other fibrous materials with india-rubber, and spreading the semi-fluid mixture on a back or ground of canvas or woollen cloth. While in this state the floor-covering undergoes a sort of embossing process, effected either plain or in colours. When it is completed and thoroughly dried, the kamptulicon will be found to have the softness of a velvet-pile carpet combined with far more durability, besides being much less in price.

KAMSIN. (*See* SIMOOM.)

KANGAROO, *kăng-gă-roo'*, a native term applied to an extensive family of animals, distinguished by the female having no *placenta*, and by their young being nursed in a peculiar pouch in the body of the mother (*See* MARSUPIALIA.) The scientific term *Macropus* is also used to designate the same family, which varies much in appearance and habits. Some are carnivorous, whilst others live on vegetables. They are nearly all confined to Australia, and are characterized by a very low degree of intelligence. The phalangers form a sub-family, having the second and third toes so completely included within the skin as to appear like a single toe, were it not for the claws, which project distinctly. They are covered with a close, thick, soft fur, and live on trees or bushes. They have a strong prehensile tail, with which they hook themselves to the branches upon which they doze during the day. They possess a very strong odour, but their flesh is eaten. In the genus *Cuscus*, the tail is long, scaly, and ratlike, and the ears are short. In the genus *Petaurus*, the skin of the body is expanded between the anterior and posterior limbs, which enables the species to leap from one tree to another. Four or five species are known, of which the most familiar is the fl[illegible] of Norfolk Island. [illegible] bears some resembla[illegible]. The *Macropina*, or kangaroos proper, have the tarsus and middle toe of the hind foot elongated, and the two inner ones rudimentary, equal, and united together. This genus has very large posterior limbs, and the tail is of remarkable length and strength. This organ is of great importance to the animal, since it is used as an organ of locomotion, a weapon of offence, and also as a third point when the kangaroo rests on its haunches. It also assists in the astonishing leaps which these animals continually take when moving about. Their progress actually consists of a series of springs, sometimes twenty feet in length. They seldom stand on all-fours, except when feeding, and are harmless and inoffensive creatures. The *Macropus major*, or great kangaroo, is the largest species. It measures five or six feet from the tip of the nose to the end of the tail, and, when sitting, appears about the height of a man. The kangaroo forms an important article of food, and the flesh is represented by those who have tasted it as being a little like venison. Soup made of the tail is said to be far superior to the ox-tail soup of Europe. Individual specimens have been brought alive into this country, and have been successfully kept in some of our parks. The great kangaroo inhabits New South Wales, Southern and Western Australia, and Tasmania. Other genera, the *Lagorchestes*, or kangaroo hare, and the *Hypsiprimnus* (*see* KANGAROO RAT), are also found in Australia. The *Dasyurus*, or opossums, which also belong to the kangaroo family, are found in America and the West Indies. (*See* OPPOSSUM, MACROPIDÆ.)

KANGAROO RAT (*Hypsiprimnus*), a marsupial animal found in Australia. It is the size of a rabbit. General colour greyish, reddish-brown above, whitish below; triangular head; large ears; tarsi very long; and tail elongated, flexible, terminated by a pencil of hairs. The manners of the kangaroo rat are gentle and timid; it feeds upon vegetables, and it is said to burrow in the ground.

KANTIAN PHILOSOPHY, *kănt'-e-ăn*, is the name given to that system of philosophy which was promulgated by Immanuel Kant, professor of logic and metaphysics in the university of Königsberg in the latter half of the 18th century, and who was one of the greatest philosophers of modern times. His system, like that of Dr. Reid, was a recoil against the scepticism of Hume, and it was equally opposed to the dogmatism of Leibnitz and Wolff. His philosophy is nearly all contained in his "Critique of Pure Reason." He insisted upon the necessity of a stricter analysis of our intellectual powers, in order to ascertain the nature, and determine the limits, of human knowledge: the result was, that a whole system of knowledge underived from experience was proved to exist in the mind. The materials of *pure* or *à priori* knowledge are supplied by the three departments of sense, understanding, and reason. In the world of sense the transcendental, or pre-existent, elements of knowledge are space and time; these are pure sensuous intuitions, without which empirical sensations would be impossible. Sense delivers up its presentations in space and time to the understanding, whose office it is to introduce into them unity and system. All its operations are generalized into modes or forms of conception, which, after the example of Aristotle, he names "Categories of the Understanding." These are,—(1) Quantity, comprising unity, plurality, totality; (2) Quality, comprising reality, negation, limitation; (3) Relation, comprising substance, cause, reciprocity; (4) Modality, comprising possibility, existence, necessity. These are the forms, as it were, in which the rude

material of the senses is shaped into conceptions, and becomes knowledge, properly so called. He laboured to show that without them no connection of the materials of sense is possible. They are the constant and invariable conditions of all mental conceptions, and are the things which connect or bind the understanding with all external objects. All our judgments he divides into two kinds,—analytical and synthetical, the former being a kind of experimental sketch, the result of a separation of the different qualities or properties of any thing, the latter being independent of experience and universal in its nature. The third, and highest faculty is the reason,—the faculty of ideas. Reason creates no new materials of its own; it only enlarges the data of the understanding, by taking in all the conditions on which they depend. "All our knowledge," he says, "begins with sense, proceeds thence to understanding, and ends with reason, beyond which nothing higher can be discovered in the human mind for elaborating the matter of intuition and subjecting it to the highest unity of thought." "Of reason, as of the understanding, there is a merely formal—that is, logical—use, in which it makes abstraction of all content of cognition; but there is also a real use, inasmuch as it contains in itself the source of certain conceptions and principles which it does not borrow either from the senses or the understanding." The three great attributes of reason are absolute unity, absolute totality, and absolute causation. All these absolute ideas are involved in every act of reasoning. There are, also, according to Kant, three grand forms or ideas soaring above pure intellect, and having an existence independent of experience, which come within the province of pure reason. These are the universe, the soul, and God. The first embraces the entire mass of all real or possible physical knowledge, forming the science of cosmology; the second, the feelings, emotions, passions, &c., which constitute our moral and intellectual nature, forming psychology; and the third, all the reasonings relative to the mode of being, the attributes, and moral nature of the Deity, forming theology. These three ideas Kant maintains to have their birth in human reason irrespective of all experience, and to spring up inevitably so as to control and influence the working of the understanding as applied to experience. As regards the moral and religious principles of our nature, these are based upon consciousness. In order to learn our duty both to man and our Maker, we must penetrate into our internal structure, examine all the motives, impulses, and aspirations of the soul, and look at the final ends or purposes which its various faculties are fitted to produce. In this way we discover the nature of duty and of right; what is necessary and what is expedient; what is good and what is pernicious. All moral laws exist *à priori* in the mind, and are completely independent of the thinking principle. The whole moral economy of man points to another great truth—that of the existence of Deity. The practical reason of mankind clearly demonstrates that there must be a supreme, universal, infinite existence. Such is a brief outline of the philosophy of Kant. The system, as a whole, looks grand and imposing, and has an air of great strength and solidity. It is hedged round with a ponderous array of logical axioms, rules, definitions, and forms, and has a phraseology at once original and scholastic. But with all these appliances, the system is strangely defective when closely examined, though its influence upon the history of philosophy can scarcely be overestimated. "Taken altogether," says Dr. Cairns, "it is impossible to regard his writings as any other than a prodigy of human intellect, and his influence as one of the mightiest forces that has ever ruled philosophical opinion. His mark is still on all the speculative sciences in Germany and Europe; and though his sceptre has long been broken, the most imposing systems meet in homage at his tomb. Great as the currency of his leading ideas has been, much still remains in his works to be developed by the struggle and collision of future systems; and it may be safely pronounced that no philosopher of the eighteenth century—perhaps none since the days of Aristotle—has left behind such monuments of thought, or has so firmly imposed the task of mastering them on the speculation of all succeeding ages."—Ret. *Encyclopædia Britannica*, s. t. *Kant*; Blakey's *History of Philosophy*; Lewes's *History of Philosophy*.

Kaolin, *kai'-o-lin* (Chinese), in Min., a pure white clay, resulting from the decomposition of felspar in granitic rocks. It was originally found in China, but has been discovered near St. Austle, in Cornwall, and at St. Yrieix, near Limoges. It consists of nearly pure silicate of alumina, with small quantities of oxide of iron, potash, and water. It is used for making the finer kinds of porcelain; also by photographers for abstracting organic matter from their nitrate of silver solutions. It has been employed to discolorize sugar, but without much success.

Kapnomor, *kap'-no-mor* (Gr. *kapnos*, smoke; *moira*, a part), in Chem., a colourless oil, of peculiar odour, boiling at 360°, obtained from crude kreasote by distillation with potash. It is insoluble in water and solution of potash, but dissolves readily in alkaline solution of kreasote.

Karaites. (*See* **Caraites**.)

Karpholite, *kar'-fo-lite* (Gr. *karpho*, I dry or shrivel; *lithos*, a stone), a mineral, which occurs in minute crystals and in stellated silky fibres. It consists principally of silica, alumina, and oxide of manganese. In colour it is straw-yellow; is able to scratch fluor spar, and is scratched by felspar. The lustre of the crystals is vitreous, and that of the fibres silky. Its specific gravity is 2·93. Before the blowpipe, karpholite fuses into a dark glass, which becomes darker in the interior flame. With borax it fuses into a transparent glass, which presents a reddish colour in the outer flame and a greenish colour in the inner.

Kat, or Khat. (*See* **Catha**.)

Kawrie Pine. (*See* **Dammara**.)

Kedge, or **Kedger**, *kedje*, *ked'-jer*, a small anchor, used to steady a ship and keep her clear from her bower anchor when riding in a harbour or river, especially at the turn of the tide, when she might, if not so secured, drive over her principal anchor and entangle the stock or flukes with her slack cable, so as to loosen it from the ground. They are also employed to remove a vessel from one part of a harbour to another: for this purpose they are carried out from her in the long-boat, and let go by means of ropes secured to them.

Keel, *keel* (Sax. *cele*, Du. *kiel*), the lowest and principal piece of timber in a ship. The carcass of a ship is not unlike the skeleton of the human body,—the keel representing the backbone, and the timbers the ribs. The entire fabric is supported by the keel; as the stem and stern posts, which are elevated on its ends, are merely continuations of it, and serve to connect and inclose the extremities of the sides by transoms, as the keel forms and unites the bottom by timbers. Some vessels are provided with what is termed a *false keel*, consisting of a strong thick piece of timber bolted to the bottom of the keel. It is chiefly employed when the planks which form the real keel cannot be obtained of sufficient depth.

Keel-hauling, a method of punishment employed in the Dutch navy, and although not entirely unknown in our own, is seldom or ever now practised. It is extremely dangerous. The culprit is generally let down from the bows under the bottom of the ship, and drawn along the length of the keel by two ropes stretched from each side of the ship; after which he is once more taken on board over the stern. By reason of the number of barnacles and other obstructions on the bottom of the ship, this punishment inflicts many cuts and bruises on the culprit, and is severe in the extreme.

Keelson, or **Kelson**, *keel'-son*, *kel'-son*, one of the principal timbers in a ship: it is laid over the keel, of which it forms the interior or counterpart, and across all the timbers inside the vessel. It consists, like the keel, of several pieces scarfed together, but of only half the breadth and thickness of those of the latter. In order that it may fit with greater security upon the floor timbers and crotchets, it is notched opposite to each to the depth of an inch and a half, and secured upon them to that depth by copper spike-nails.

Keep. (*See* **Castle**.)

Keeper, *keep'-er* (Ang.-Sax.), means, literally, one who holds possession of anything for the use of another. The *keeper of the forest*, or chief warden, is an officer

who has the principal government of all things connected with royal forests, and is above all other officers having rule over the same. The *keeper of the touch* was the name formerly given to an officer of the royal mint, now called the *master of the assay*. (*See* LORD-KEEPER.)

KELP, *kelp*, the ashes of seaweed, from which are extracted iodine and bromine. A ton of good kelp yields about 8 lbs. of iodine by the ordinary and [illegible] process of working. Mr. E. C. C. Stanford, by carefully collecting and compressing the weed, and afterwards submitting it to dry distillation, not only doubles the yield of iodine and bromine, but obtains various valuable hydrocarbon oils. The shores washed by the Atlantic are those which yield the richest seaweed for the manufacture of kelp.

KENNEL, *ken'-nel* (Fr. *chenil*), a term properly applied to the house in which a pack of h[illegible], but frequently used to denote the [illegible]. [illegible] kennel constructed by the duke of Richmond for his hounds cost £10,000; it is well drained, healthily situated, and provided with airing-yards, breeding-places, &c., together with dw[illegible]-houses for the huntsman and whipper-in. [illegible] kennels [illegible] highly spoken of on account of their maintaining an equable temperature.

KEPLER'S LAWS, *kep'-lerz*, the term applied by astronomers to the statement of certain analogies tha[t] exist between the relative distances of the planets from the sun and the times in which they complete their revolutions round that body, and also between the rate of motion at which any heavenly body travels in its orbit, and its distance from the body or centre about which it revolves. Kepler's first law, so called because it was the first which was discovered and enunciated by that astronomer, is that "equal areas are described in equal times" By this it is meant that if a straight line were drawn from the earth to the sun, round which the earth revolves, the line would pass over equal portions [illegible] area of the ellipse which the earth describes in its orbit in equal times, wh[illegible] the planet might be in it[illegible] Kepler arrived at this conclusion from obs[illegible] pl[illegible] velled fastest when they were [illegible] the sun, their perihelion, and slowest when they were at the aphelion, or greatest distance from the body. His second law, which was deduced, like the first, from observations of the planet Mars, is that "planets describe ellipses, having the sun as a common focus," while his third is that "the squares of the periodic times of the planets are in proportion to each other as the cubes of their mean distances from the sun."—*Ref.* Herschel's *Outlines of Astronomy*.

KERI-CHETIB, *ke'-re ket'-ib*, a term applied, in Philol., to various readings in the Hebrew Bible. The signification of *keri* is, that which is read; while *chetib* means that which is written. When instances of such readings occur, the *chetib*, or false reading, is placed in the text, while the *keri*, or true reading, is placed in the margin with a Hebrew character under it. The number of keri-chetibs is estimated at a thousand, and most of them are attributed to Ezra; but, as several corrections of this kind appear in his own writings, it is probable that many were made at some subsequent period.

KERMES MINERAL, *ker'-mez* (Arab. *kirmer*), a compound used in Med., consisting of a mixture of teroxide and tersulphide of antimony. It is prepared by boiling finely-powdered sulphide of antimony with carbonate of soda and a large quantity of water. The liquid, as it cools, deposits the kermes, which is collected on a filter and dried at a low temperature. Its chemical composition may be represented by the formula $2SbS_3, SbO_3$, according to Liebig; but crystals of the teroxide of antimony may be easily descried with a microscope.

KERR RIFLE, *ker*, a rifle manufactured by the London Armoury Company, at their works in Bermondsey, S.E., and which takes its name from Mr. Kerr, the inventor of the principle on which the interior of the barrel is grooved. The barrel is interchangeable with that of the machine-made long Enfield rifle, constructed by the same company; but it is superior to the Enfield barrel in being shorter, smaller in the bore, and sighted on a different principle. The bore is ·451 inch in diameter, with six grooves, cut on what is called the "ratchet" principle; that is to say, the grooves are deeper on one side than on the other, the deepest part being on the side from which the bullet turns, which has the effect of reducing the resistance of the air to a minimum. The lands are left from the original cylindrical bore of the barrel; and as the bore itself is mechanically and mathematically true, the lands must be perfectly true also. At the breech, and where the charge lies, the grooves are nearly straight. This is the chief point in Mr. Kerr's patent, in which barrels bored on his principle differ from those of other inventors and makers. By this simple arrangement, and the absence of all angles in the grooving, fouling is obviated, while the straightness of the grooves at the breech allows the bullet to expand properly into them before it commences the [illegible] rotatory motion. The barrel is 37 inches in length, and its weight is 5¼ lbs. The bullet is cylindro-conoidal in form, and weighs 530 grains; it has a diameter of ·442 inch, which leaves a windage of ·009 inch. A solid greased wad is used in loading, and the charge is 2½ drachms of No. 6 powder, up to 700 yards, beyond which range it may be increased to three drachms with advantage. The fore-sight, either bead or knife, moves transversely in a dovetail, in front of which there is a graduated scale, to show to what extent the sight is shifted to the right or left of the centre. A screw is used to fix the fore-sight in the required position. By this due allowance may be made at all times for the effect of the wind. The precision of the machinery employed causes this rifle to be more accurately finished than those which are made by hand. It is a cheap and trustworthy weapon; and its excellence, and the correctness of the theory on which the principles adopted in its construction are based, are clearly demonstrated by the good practice that has been made with it in trials at the Royal Arsenal, Woolwich, and elsewhere.

KERSEY, *ker'-ze*, a sort of rough cloth, generally ribbed and woven from long wool. The name is probably a corruption of *Jersey*, from which island it originally came. Kersey is principally manufactured in the North of England. *Kerseymere* is a very different fabric, it is a thin stuff, generally woven plain from the finest wools. It is said to derive its name from Cashmere, a country where the finest wool is produced, and consequently much celebrated for its woven cloths. Kerseymere is principally manufactured in the western districts of England.

KESTREL, *kes'-trel* (Ang.-Nor.), (*Falco tinnunculus*), one of the most common species of the British *Falconidæ*. It is elegant in shape, attractive in colour, and graceful in its movements through the air, and is best known by its habit of sustaining itself in the air in the same place, by means of a short but rapid movement of its wings. During this pause, its powerful eyes search the surface beneath for mice, which form its principal food. The kestrel is also called the windhover, from this habit of remaining suspended in the air. On all such occasions, its head points to windward. Although the kestrel lives principally on mice, it also attacks and devours small birds. The kestrel frequently takes possession in spring of the nest of a [illegible] or magpie in which to deposit its eggs. Sometimes, however, they build in high rocks or old towers. [illegible]y lay four, and occasionally five eggs. The kestrel is found in nearly all parts of the world. In length, it is from thirteen to fifteen inches, dependent upon the sex. In the male, the beak is blue, pale towards the base; the top of the head and nape of the neck ash-grey, with dusky streaks; the back and wing-coverts reddish fawn-colour, with small black triangular spots, [illegible]e occupying the point of each feather; the tail-[illegible]thers are ash-grey, with a broad black band near the end, each feather being tipped with white; the breast and belly are pale rufous fawn-colour, with streaks on the former and dark spots on the latter; the legs and toes are yellow, and the claws black. The colour of the female differs little from that of the male, the under surface of the tail-feathers of the former [illegible]g more uniform in colour, and less distinctly barred [illegible]an in the male.

KETCH, *ketsh* (Fr. *quaiche*; Ger. and Du. *kits*), a vessel of about 100 to 250 tons burden, carrying two

masts; viz., a main and mizen mast, chiefly employed as yachts, but sometimes built very strong, and used as bomb-vessels. (*See* BOMB-KETCH.)

KETCHUP, or CATSUP, *ketsh'-up*, the juice of certain vegetables, strongly salted and spiced, so as to be used as sauce. The best-known ketchup is that made from mushrooms. For its manufacture, the following will be found a useful receipt:—Sprinkle mushroom flaps gathered in September with common salt; stir them occasionally for two or three days; then lightly squeeze out the juice, and add to each gallon cloves and mustard-seed, of each bruised ½ oz.; allspice, black pepper, and ginger, of each bruised 1 oz.; gently heat to the boiling-point, in a covered vessel, macerate for fourteen days, and decant or strain. Should it exhibit any indications of change in a few weeks, boil it again, with a little more salt and a little more spice. In preparing ketchup, vessels made of glazed earthenware or stone-ware, or well-tinned copper pans, only should be used.

KETONES, or ACETONES, *ke'-tonez*, a series of compounds obtained from volatile organic acids, the normal hydrates of which contain four equivalents of oxygen, by submitting their lime, or baryta-salt, to dry distillations. Acetone, $C_6H_6O_2$, may be taken as the type. (*See* ACETONE.)

KETTLE-DRUM. (*See* DRUM.)

KEY. (*See* LOCK.)

KEY-BOARD, *ke'-board*, a name applied in Mus. to that portion of a pianoforte, organ, harmonium, &c., upon which those pieces of wood or ivory, called keys, by means of which the sounds are produced, are placed. The key-board of a pianoforte presents various numbers of keys, according to the compass of the instrument to which it belongs; thus, one containing six octaves presents forty-three white keys and thirty black; the black keys representing the sharps and flats, and the white, the natural notes.

KEYS, those movable projecting levers of ivory or wood which are placed on the key-boards of all such instruments as the pianoforte, organ, or harmonium, &c., to receive the fingers of the performer.

KEYS, or KEY-NOTE, in Mus., a certain fundamental sound or tone, to which the whole of a piece must have a certain bearing, and with which it usually begins and always ends. There are only two principal keys; viz., the major, or that of C, and the minor, or that of A. From these two natural keys are deduced all the other keys in which we employ flats and sharps. The key in music is the same as the subject in an oration: in the latter, some principal person or thing, to which the discourse is referable, is always kept in view; so in every regular piece of music there is one fundamental note,—viz., the key-note, by which all the rest are regulated, and with which the piece begins and ends. Again, in an oration there may be several distinct articles which refer to different subjects, at the same time having a visible connection with the principal subject; so in a musical composition, there may be several keys to which the different parts belong, but they must all be under the influence of, and have a sensible connection with, the principal key.

KEYS, POWER OF THE, is a power claimed by Roman Catholics for the pope to open and shut paradise when he pleases, founded upon the saying of Jesus Christ to Peter,—"I will give thee the keys of the kingdom of heaven" (Matt. xvi. 19). It denotes the power of inflicting spiritual punishment and of absolving from it.

KEY-STONE, in Arch., is the stone placed at the top or vertex of an arch to bind the two sweeps together. In the Tuscan and Doric orders it is merely a plain stone projecting a little; in the Ionic it is cut and waved somewhat like consoles; and in the Corinthian and Composite orders, it is a console ornamented with sculpture. In making an arch, the length of the key-stone, or thickness of the archivolt at top, is allowed by the best architects to be about one-fifteenth or one sixteenth of the span.

KHALIF. (*See* CALIF.)

KHAN, kân, is a Tartar word, signifying sovereign or chief. It is a title adopted by the sovereign princes of Central Asia, and is one of the titles of the Turkish sultan. It was first assumed by Gengis when he became supreme ruler of the Moguls and Tartars. In Persia the word is used i[illegible]xtended sense, being applied to governors of provinces and officers of a certain rank. Khan is also the Turkish name for a caravansary, a place for the accommodation of travellers. (*See* CARAVANSARY.)

KHOTBAH, *kot'-bah* (Arab.), a particular form of prayer used by the Mohammedans at the commencement of public worship in the great mosques on Friday, at noon. It was originally performed by the prophet himself, and by his successors, up to A.D. 906. At that time Mohammed VIII. appointed special ministers for the purpose, and that arrangement has been adhered to ever since. The khotbah consists of a confession of faith in the Mohammedan religion, and a general petition for its success. It is divided into two portions, between which the officiating priest makes a considerable pause, which is regarded by the worshippers as the most solemn part of the ceremony. The sultan of Turkey has always considered it one of his chief prerogatives to have his name inserted in the khotbah.

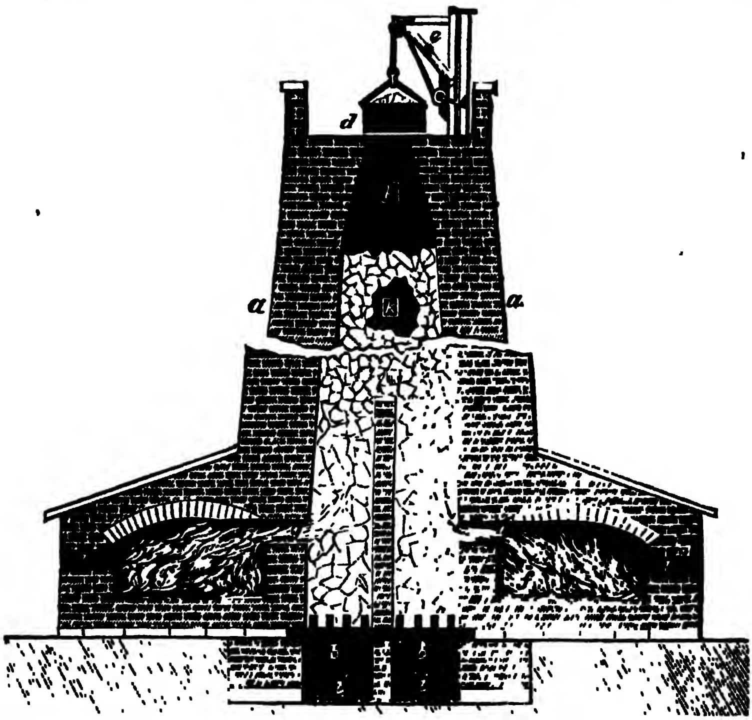
KIDNAPPING, *kid'-nap-ping* (Ang.-Sax.), in Law, is the forcible abduction and conveying away of a man, woman, or child, from their own country and sending them to another. It is an offence at common law, punishable by fine and imprisonment, and formerly also by pillory. According to the Jewish law, "He that stealeth a man and selleth him, or if he be found in his hand, he shall surely be put to death."—(Exod. xxi. 16.) By the civil law, likewise, the offence of spiriting away and stealing men and children, called *plagium*, was punishable with death. By 9 Geo. IV. c. 31, the wilfully leaving any man on shore, or refusing to bring him home, by the master of any merchant vessel, is a misdemeanour, and punishable by imprisonment for such time as the court may direct. The same statute declares, that if any person shall maliciously, either by force or fraud, lead or take away, or decoy or entice away, or detain, any child under the age of ten years, he shall be guilty of felony, and, being convicted thereof, shall be liable to be transported beyond the seas for the term of seven years, or to be imprisoned, with or without hard labour, for a term not exceeding two years; and (if a male) to be once, twice, or thrice publicly whipped (if the court shall see meet) in addition to such imprisonment.

KIDNEY, *kid'-ne* (Ang.-Sax.; Lat. *ren*), in Anat., is the name of a double gland, having for its office the secretion of the urine. The form of the kidney resembles that of a French bean; its average length being from four to four and a half inches, its breadth two inches, and its thickness one inch. The two kidneys are situated in the lumbar region, one on each side of the spine, on a level with the last two dorsal and the first two lumbar vertebræ: they are of a brownish-red colour, flattened from before backwards, and grooved on the interior border for the great vessels. They are covered by a thin, firm, transparent cellular envelope; and internally are composed of two substances,—an exterior or cortical, and an interior or medullary. The cortical substance is the seat of the greater part of the secretory process, and is made up of a great number of uriniferous tubes, much convoluted, and inosculating with each other, and lined with epithelial cells of a spheroidal and projecting form. Scattered through the plexus formed by these tubes and the blood-vessels, are dark points, which have been called *corpora Malpighiana*, from their discoverer. These last are convoluted masses of minute blood-vessels included in flask-like dilations of the uriniferous tubes, forming a close relation between the circulating and secreting systems. The medullary substance is composed principally of tubes passing nearly straight inward to the central receptacle of the secretion. Both substances are imbedded in interlacing fibres, most abundant in the medullary. The kidneys are well supplied with blood-vessels and nerves, in accordance with the importance of their function. The renal arteries come directly from the aorta, and the large veins terminate in the vena cava. The nerves come from the renal plexus. The renal arteries divide, soon after entering the organs, into minute twigs, which pierce the capsule of the Malpighian tufts. From the convolutions of these tufts arise the efferent vessels, which surround the uriniferous tubes, and from which the renal veins are formed; and thus the urinary secretion is produced from

blood which has passed through the Malpighian capillaries.

KIDNEY, DISEASES OF THE.—The kidneys are subject to a variety of dangerous and painful diseases, arising from various causes. They may be arranged in two distinct classes,—those which are the result of some cause acting locally, as calculi, retention of urine, or a blow on the loins, and those which are the result of a constitutional cause acting upon the kidney by inducing an abnormal condition of the blood. (For disease of the kidney arising from renal calculi, *see* CALCULUS.) In retention of urine, the ureter, pelvis, and infundibula become much dilated, and the cortical substance expanded and lobular on the surface. The mucous membrane frequently becomes ulcerated, inflammatory deposits occur in the substance of the kidney, and the gland is destroyed by a slow atrophy, or more rapidly by suppurative inflammation. Both kidneys are usually affected, but in different degrees. Disease of the kidney from external violence is not of frequent occurrence. Among the diseases resulting from a constitutional cause is scrofulous disease of the kidney, which occurs in the form of small scattered deposits of tubercular matter, or it presents itself in the form of a thick curdy deposit, which leads to the formation of a large abscess. Cancer of the kidney is a disease less uncommon than it was formerly supposed to be. In the great majority of cases, some of the neighbouring parts are complicated, in one or other of which the disease obviously originated. Hydatids are occasionally found in the kidney. They are generally numerous or multiplied, and contained in a mother-cyst, which frequently acquires a large size, forming a tumour which may be often felt externally. Inflammation of the kidneys (nephritis) is characterized by pain in the lumbar region, often extending anteriorly through the abdomen, or descending to the groin and testes, with retraction of the latter, disordered state of the urinary secretion and excretion, febrile disturbance, sometimes numbness of the thigh, and nausea or vomiting. The whole of these symptoms are not always present, except in some of the more severe cases. Inflammation of the kidneys, like other inflammatory diseases, results from cold, wet, intemperance, &c; and its treatment requires to be very active, local depletion by leeches, and cupping, being freely employed, followed by warm fomentations. (*See* BRIGHT'S DISEASE.)

KILN, *kil* (Sax. *cyln*).—A structure or machine for drying substances by the application of heat. Their forms are as various as the substances or manufactures for which they are designed, for although a certain kiln will answer several purposes, yet for a single purpose, a variety of kilns are frequently applied. A good kiln should possess the requisite qualities of cheapness and durability of construction, effectiveness in producing the result required with the utmost economy of fuel, a perfect command of the temperature, and facility of working. Ovens must be regarded as of the same class of apparatus as kilns—indeed, the terms kiln and oven are often applied indiscriminately to the same structure. Under the head of LIMEKILN the usual form of that apparatus is described. In this place we shall describe Mr. Heathorn's patent combination of a limekiln with a coke oven. The object of this invention, as expressed in the specification of the patent, is the preparation of quicklime and coke in the same kiln at one operation. The accompanying fig. represents a vertical section of the lime-shaft and coke-ovens. *a*, *a* are the side walls—four feet thick—of a rectangular tower, the internal space being filled with limestone from the top to the iron bars *b*, *b*, at the bottom, whereon the whole column rests. The limestone is raised in a box (*d*) or other receptacle to the top



KILN.—LIME-SHAFT AND COKE-OVENS.

of the building by means of a jib and crane (*e*), or other tackle, which is fixed at the back of the tower, together with a platform projecting beyond the walls, for affording security and convenience for "landing" the limestone; when raised as represented, the jib is swung round and the lime-box tilted, by which the whole contents are thrown down the shaft. The coke-ovens, of which there may be two or a greater or less number, according to the magnitude of the works, are constructed and arranged in connection with the lime-shaft in the same manner as the two represented in the diagram at *f f*. These ovens are supplied with coal through iron doors in the front wall (not seen in the section): the doors have a long and narrow horizontal opening in the upper part of them to admit sufficient atmospheric air to cause the combustion of the inflammable or bituminous part of the coal; the flames proceeding thence, pass into the lime-shaft through a series of lateral flues (two of which are brought into view at *g*, *g*), and the draught is prevented from deranging the process in the opposite oven by the interposition of the partition-wall *h*, which directs the course of the heat and flames throughout the whole mass of the lime, the lowermost and principal portion of which attains a white heat, the upper a red heat, and the intervening portions the intermediate grades of temperature. When the kiln is completely charged with lime, the openings in front and beneath the iron bars at *i i* are closed and barricaded by bricks and an iron-cased door, which is internally filled with sand to exclude the air and prevent the loss of heat by radiation. Therefore when the kiln is at work, no atmospheric air is admitted but through the narrow apertures before mentioned in the coke-oven doors. When the calcination of the lime is completed, the barricades *i*, *i* are removed, the iron bars *b*, *b* are drawn out, by which the lime falls down and is taken out by barrows. It sometimes happens, however, that the lime does not readily fall, having caked or arched itself over the area that encloses it, in which case a hooked iron rod is employed to bring it down. To facilitate this operation in every part of the shaft where it may be necessary, a series of five or six apertures, closed by iron doors, is made at convenient distances from the top to near the bottom of the shaft; two of these are brought into view at *k*, *k*. Two similar apertures are shown in section *a i*, the coke-ovens at *b*, *b*, which are for the convenience of stoking and clearing out the lateral flues *g*, *g* from any matter that might obstruct the free passage of the heated air. When the coals have been reduced to coke, the oven-doors in front (not shown) are opened and the coke taken out by a peel iron, the long handle of which is supported on a swinging jib, that acts as a movable oven. The operation of this kiln is continuous, the lime being taken out from the bottom whenever it is sufficiently burned, and fresh additions of raw limestone being constantly made at the top.

KILOGRAMME. (*See* METRIC SYSTEM.)

KIN OR KINDRED, *kin*, *kin'-dred* (Ang.-Sax.), in Law, is applied to certain persons of kin, or related to each other. There are three degrees of kindred recognized in law,—one in the right line descending, another in the right line ascending, and the third in the collateral line. In the right line descending, the kindred of the male line are called *agnati*; of the female, *cognati*. It proceeds from father to son and daughter, grandson and granddaughter, and so on. The right line ascending is directly upwards, from son to father and mother, grandfather and grandmother, &c. The collateral line is either descending by the brother or sister, and their children downwards, or ascending by uncle or aunt, grand-uncle, grand-aunt, &c., upwards. There are several rules to know the degrees of kindred. In the ascending line, take the son and add the father, and it is one degree ascending, then add the grandfather, and it is a second degree (a person added to a person in the line of consanguinity making a degree); and if there are many persons, take away one, and you have the number of degrees; thus, if there are four persons, it is the third degree; if five, the fourth, &c.; so that father, son, and grandson, in the descending line, make but two degrees. To know in what degree of kindred the sons of two brothers stand, begin with the grandfather, and descend to one brother, the father of one of the sons, which is one degree; then to his son, the ancestor's grandson, which is a second degree; and then descend again from the grandfather to the other brother, father of the other of the sons, which is one degree, and descend to his son, which is a second degree; thus, the sons of two brothers are distant from each other two degrees, for in what degree either of them is distant from the common stock, the person from whom the computation is made, they are distant between themselves in the same degree; and in every line the person must be reckoned from whom the computation is made. If the kindred are not equally distant from the common stock, then in what degree the most remote is distant, in the same degree they are distant between themselves; and so the line of the most remote makes the degree.

KING, *king* (Sax. *cyning*, Swed. *kong*, Germ. *könig*), the title given to the principal person in any state, who [illegible] a greater or less degree of sovereign power, [illegible] the nature of the laws of that state, and in whom the principal exective functions are vested. The term itself is of Teutonic origin, and implies a person who has attained a greater degree of knowledge [illegible] him, and is therefore entitled to ex- [illegible] among them. In former times this knowledge would consist chiefly of an intimate acquaintance with the arts and stratagems of war, by which he was enabled to gain the mastery over any portion of his own people who might be disposed to dispute his authority, as well as over hostile tribes and nations. The first king of England was Egbert, originally king of Wessex, who brought under his sway the other kingdoms of the Saxon Heptarchy, and united them under himself as sole sovereign. This monarch, and some of his immediate descendants, seem to have deserved the title in the strict signification of the Saxon word *cyning*, or king, from their skill and excellence in the arts of peace and war. The office of king is hereditary in England, and has been so ever since the accession of William the Conqueror, although the descent has not been preserved in an unbroken line from father to son since that time, but has passed into other branches of the royal family, or into families closely allied to them by marriage. At present, in accordance with the spirit of the saying, "The king never dies," the king or queen of England, as the case may be, comes to the throne immediately on the death of his or her predecessor, and enjoys full and immediate possession of the sovereign power; but formerly, a short period of time elapsed between the close of the reign of one king and the commencement of the reign of his successor, which was requisite to a certain extent to obtain some recognition of the authority of the latter from the people. At his coronation, the reigning sovereign of England enters into a solemn contract with the people to govern according to the laws, to cause justice to be duly administered, and to maintain the Protestant church. The person of the king is sacred, and no legal measures can be taken against him to bring him to account for any act that he may have committed; but, according to the constitution of the government of this country, it is impossible for the monarch to do anything prejudicial to the interests and welfare of the people, as the king always acts through his ministers, who may be impeached for any transgression of the laws, and the houses of parliament and the people, through their representatives in the House of Commons, virtually exercise a direct control over his power, since no law can be brought into operation and enforced without the concurrence of both these bodies, although, at the same time, every enactment passed by them requires the royal assent before it becomes the law of the land. It is the province of the sovereign to send embassies, to conclude treaties, and make war and peace with other nations. He bestows titles; convenes, prorogues, and dissolves parliament; appoints the judges and high officers of state, the bishops and governors of colonies, and grants commissions to officers in the army and navy. Charters of incorporation for companies, collegiate bodies, and towns, are also granted by the king. Some monarchs are styled emperor instead of king; but the functions discharged by both are similar, although the title seems to imply supremacy of an absolute nature, and does so in some cases. The words czar, sultan, and shah, ap-

plied to the monarchs of Russia, Turkey, and Persia, and elector and grand-duke applied to the rulers of Hesse-Cassel and many of the smaller German states, are equivalent to the term king.

King-at-Arms. (*See* Herald's College.)

Kingfisher. (*See* Alcedo.)

Kings, the Books of, is the name of two of the historical books of the Old Testament. Originally, they formed only one book, and were first divided by the Seventy, by whom they are entitled the third and fourth books of Reigns or Kingdoms, the books of Samuel, which they divided in the same way, being the first and second. The books of Kings take their name from their contents, being a history of the theocracy under the kings from the reign of Solomon till the dissolution of the state. They may be divided into three parts,—1. giving an account of the reign of Solomon (i.—xi.); 2. the history of the two kingdoms of Judah and Israel (xii.—2 Kings xvii.); 3. the history of the kingdom of Judah after the breaking of Israel (xviii.—xxv.). The period embraced by the two books is 455 years. Great uncertainty exists as to the author and the time at which these books were written: some ascribe the authorship to Ezra, others to Jeremiah or Isaiah; but it is mere matter of conjecture. Jewish tradition ascribes the authorship to Jeremiah, and there is present throughout a considerable resemblance to his style. The books, though compiled to a considerable extent from more copious annals, yet present a tolerable degree of unity and compactness. A definite plan is seen running through the whole, and there is a uniformity of style and method. The scope of the work is to show God's merciful dealings with his people, and his keeping promise with them. The kingdom is preserved to Solomon entire, and after it was divided, God endeavoured to recall both Israel and Judah to a sense of their covenant-relation to him by admonitions and chastisements, though they were finally subverted because they continued rebellious and stiff-necked. But though severely punished, the seed of David was not allowed to perish, and the exiled king Jehoiakim is brought back to Judah and set upon the throne of his ancestors, as an evidence of God's remembrance of his promises made to his servant David. The historical character and credibility of these books commend themselves to the reader by strong external and internal evidence; besides their being repeatedly referred to in the New Testament. The Jews have uniformly regarded them as divinely inspired.—*Ref.* Horne's *Introduction to the Holy Scriptures.*

King's or Queen's Bench, Court of. (*See* Court of Queen's Bench.)

King's College, London, is an educational institution occupying the east wing of Somerset House, which was built up to receive it, having before been left incomplete. The site was presented to the college by George IV. King's College owes its origin mainly to the opposition made by the friends of the Church to University College, on the ground of theology having no place in its curriculum. They therefore set about establishing another institution of a similar kind, but on principles which accorded with their views. The funds for the institution were raised partly by shares and partly by donations; and a charter of incorporation was obtained in 1829. The fundamental principle upon which it was established was, "that every system of general education for the youth of a Christian community ought to comprise instruction in the Christian religion, as an indispensable part, without which the acquisition of other branches of knowledge will be conducive neither to the happiness of the individual nor the welfare of the state." The queen is patroness of the institution, and the archbishop of Canterbury is visitor. There are sixty-three professorships and lectureships, in the several departments of theology, science and general literature, the applied sciences, and medicine. Rooms are provided within the walls of the college for a limited number of matriculated students, under the superintendence of the censor. There is also a school in connection with the college.

King's Evil. (*See* Evil, King's, and Scrofula.)

King's Yellow, a pigment of a fine yellow colour, which is a mixture of arsenious acid and tersulphide of arsenic or orpiment.

Kinic or Quinic Acid, *ki'-nik*, a peculiar dibasic acid, occurring in chinchona bark, in combination with lime and the chinchona alkaloids. It is prepared by mixing an aqueous decoction of the bark with milk of lime, until a faint alkaline reaction is perceived, the tannic acid and the alkaloids being precipitated and kinate of lime remaining in the supernatant liquor. The salt is crystallized from the mother-liquor by evaporation, and decomposed by oxalic or sulphuric acid. Kinic acid crystallizes in colourless oblique rhombic prisms, freely soluble in boiling water, less so in cold water, and still less so in alcohol and ether. Most of the kinates are soluble in water, with the exception of the sub-kinate of lead.

Kino. (*See* Pterocarpus.)

Kinone, *ki'-none*, a yellow crystalline substance, obtained by heating one part of kinic acid, four parts of peroxide of manganese, and one part of sulphuric acid, diluted with water. It crystallizes in long needles, which fuse at 212° Fahr. It is sparingly soluble in water, but dissolves more freely in alcohol.

Kiosk, *ki-osk'*, a Turkish word, signifying a pavilion or summer-house, with a tent-shaped roof open on all sides, and isolated. It is generally square in shape, and supported by pillars, round the foot of which is a balustrade. From Turkey and Persia, the kiosk has been introduced into the English, French, and German gardens. It is built of wood, straw, or similar materials, and is chiefly erected to afford a free aspect in the shade, while, at the same time, it embellishes a rural or garden view.

Kipper, *kip'-per* (Teut. *kippen*, to hatch, from which the English word *chip*, to break the egg), a term applied to a salmon taken out of season, or at spawning-time, when it is unfit to be eaten. The term is also used in Scotland to signify fish which have been cured by means of salt and pepper; as, kippered salmon, kippered haddock.

Kirchen-tag, *kirk'-en-täg* (Ger., church diet), a Protestant association, founded in Germany in 1848. It is of the nature of the Evangelical Alliance in this country, but takes a wider range of subjects, embracing questions of social reform, as well as those of a more strictly religious nature. The inner mission is specially patronized by it. It consists of delegates, lay and clerical, from the more important religious communions, but it is possessed of no legislative power. Its doctrinal basis rests upon the confessions of the 16th century. It is to be regretted that the power for good, of this association, has been much weakened by the fierce animosities which have arisen within it, in the discussion of questions that have come before it. Bethmann-Hollweg, the late Prussian minister for religion and education, has been a leading member of this association, and presided at its meetings.

Kirk Session. (*See* Session.)

Kirschwasser, *kersh'-väs-ser* (Ger., cherry-water), a spirituous liquor, obtained in Germany by fermenting the sweet and small black cherry. From the rude manner in which this beverage is obtained from the bruised fruit, and from the distillation of the cherry-stones (which contain prussic acid) with the liquor, it has frequently a nauseous taste, and is sometimes poisonous. When properly made and sweetened, it bears a close resemblance to noyau in taste.

Kiss, *kis* (Sax. *cyssan*, to kiss).—Among the first

greeting with a holy kiss. The practice of saluting each other at the sacrament of the Lord's supper was long observed in the Church, being omitted only on Good Friday, on account of the treacherous kiss of Judas. The practice appears to have ceased in the 13th century.

Kit-Cat Club is the name of a celebrated association, founded in London about 1688. It was originally formed for convivial purposes, and met in Shire Lane, in the house of Christopher (Kit) Cat, who supplied the members with mutton pies, and gave name to the club. Most of its members being Whigs, it gradually assumed a political character, and came to be regarded as the head-quarters of the friends of the Hanoverian succession. It comprised among its members, Addison, Steele, Walpole, Marlborough, and Sir Godfrey Kneller. It was dissolved in the year 1720. The fame of

the club has been chiefly handed down by the collection of portraits of the members, painted by Sir Godfrey Kneller.

Kite, *kite* (Sax. *cyta*), in Ornith., one of the *Falconidæ*, readily distinguished even at a distance on the wing, by its long forked tail. Its flight is characterised by gracefulness and ease, and in some districts it retains the old name of gled or glead, probably derived from the Saxon *glidan*, to glide. Sometimes the kite flies in circles, governing the curve with its rudder-like tail; it then stops, and remains stationary for a time, with its tail expanded widely and its wings fully stretched out. The kite is distinguished from the falcons and hawks generally by pouncing on its prey upon the ground. It preys upon moles, frogs, leverets, rabbits, snakes, and particularly on the young of various gallinaceous birds. Like the sparrow-hawk, it frequently visits the poultry-yard; but it is deficient in courage: hens have been known to drive a kite away by the noise of their cackling. The kite has become comparatively rare in England. Its nest is formed of sticks, and lined with various soft substances, and is usually placed in the forked branch of a tree in a thick wood. It lays two, and sometimes three eggs, of a soiled white colour, marked with a few reddish-brown spots over the larger end. The eggs are laid early in the season, and the birds defend their nest vigorously against all intruders. The principal colours of the feathers are brown, dusky grey, and white. The females are rather larger than the males, but there is hardly any difference in their plumage.

Kite, a well-known toy, formed of a slender framework of wood and packthread, and terminating in a curve at one end and in a point at the other; the whole being covered with paper. Near the centre of gravity, a long string is attached, the end of which can be held in the hand. In order that the kite may be raised in the air, it is necessary that its flat surface be held obliquely to the direction of the wind. To effect this, a string or *tail*, carrying some light substance, is attached to the pointed end of the kite, and thus the proper inclination is maintained by means of its gravity. When the wind impinges obliquely on the exposed surface, its force is divided into two parts; one of which, that perpendicular to the surface, is counterbalanced by the string held in the hand; while the other, parallel to the surface, is expended in causing the kite to ascend. The wind acts with the greatest effect when the perpendicular to the surface is inclined to the direction of the wind, that is, to the horizon, in an angle of about 54¾ degrees. The kite was first used by Benjamin Franklin in America, and Romas in France, to show that lightning and the electric spark are identical.

Kleptomania, *klep'-to-mai'-ne-ă* (Gr. *klepto*, I steal, and *mania*, madness), in Law, is applied to a species of insanity which manifests itself in an irresistible propensity to steal.

Knave, *naiv*, an old Saxon word, which, in its original signification, denoted a boy; whence a knave child is used by several old writers to denote a boy, as distinguished from a girl. Afterwards it came to signify a servant boy, and at length any male servant. It was also applied to the servant or officer that bore the weapon or shield of his superior. In its present use, it denotes a false, dishonest, or deceitful fellow.

Knee, The, *nee* (Sax. *cneow*, Ger. *knie*, Dan. *knæ*), in Anat., is one of the most important joints of the human body, and is formed by three bones,—the lower extremity of the femur or thigh-bone, the upper extremity of the tibia or larger bone of the leg, and the patella or knee-pan, which is situated in front of the joint, and serves to protect it from injury as well as to afford leverage to the muscles of the thigh in moving the leg. It is a small flat triangular bone, anteriorly a little convex and rough, for the insertion of muscles and ligaments; posteriorly smooth, covered with cartilage, and divided, by a middle longitudinal ridge, into two slightly concave surfaces, corresponding with the two convex eminences or condyles of the femur. The entire joint is bound together by a number of ligaments.

Kneeling, as a posture in prayer, is recommended by numerous examples in Scripture, and prostration was occasionally practised as a sign of deep humiliation and contrition. By the early Church, kneeling was understood to denote humility of mind before God, and to indicate that man was a fallen creature before God, and needed mercy. From Tertullian and others, we learn that it was the custom in their time not to kneel, but to stand during prayer on Sundays,—said to be emblematic of Christ's resurrection from the dead and the forgiveness of sins.

Knees, crooked pieces of timber having two branches or arms, generally used to connect the beams of a vessel with her sides or timbers. The angle formed by the branches of these knees is of greater or smaller extent, according to the mutual situation of the timbers they are intended to connect; they strongly resemble a common bracket, and are used in a like manner, one arm being bolted to the deck-beams and the other to a corresponding timber in the ship's side. Knees are of great use, as they not only connect the beams and timbers together in one solid frame, but contribute greatly to the strength and solidity of the vessel.

Knight, *nite* (Sax. *cniht*, the king's servant), a title of honour, which gives the person to whom it is applied precedence next to a baronet, and above an esquire. A knight takes the title of "Sir" before his Christian name, and the wife of a knight is styled "Lady," although her legal appellation is that of "Dame." The title seems to have been first adopted when the feudal system came into operation in Europe. (*See* Knighthood.) It is now occasionally bestowed for services in the field, or for attainments in literature and distinction in various branches of science and art. In addition to those who are simply knights by royal creation, there are others who are knights in virtue of belonging to the first and second class of some order of knighthood, especially the order of the Bath. (*See* Bath, Order of the.) There are also some who are styled knights and belong to some inferior order which does not carry rank with it, and who do not in consequence prefix the title of "Sir" to their Christian names, such as the Naval Knights of Windsor; and there are degrees of knighthood connected with Freemasonry which are merely nominal, and are not recognized except by the members of the society, although the recipients assume the knight's helmet (*see* Helmet), and wear it on their armorial bearings. The degrees of knighthood to which allusion has been made are those of Knight Commander of the Temple, Knight of St. John of Jerusalem, &c. The sovereign alone has the power of conferring knighthood, which is done by laying the blade of a sword on the shoulder of the recipient of the honour, and uttering a short form of words, by which he is declared to be a knight. The lord-lieutenant of Ireland, as representative of the sovereign in that country, has also the power of granting this honour. In feudal times there was another description of knight, who was termed a knight banneret. (*See* Banneret.)

Knighthood, *nite'-hood*, a term which is applied to the institution to which knights belong. The order of knighthood, when it was first established as a general system, was a purely military institution, which dates its commencement as such from the beginning of the 11th century. It arose out of the disturbed state of Europe which prevailed after the dismemberment of the empire of Charlemagne, when all owners of territory, whether small or great in extent, erected a castle on it for purposes of defence, and were constantly engaged in committing acts of aggression on each other and on the persons of peaceful travellers. To put an end to the practice of these enormities, the leading men in various states entered into a league for the mutual protection of each other's property and families. This league ultimately became the institution of knighthood. Admission into the order was attended by a religious ceremonial, and all members were obliged to take upon themselves a vow of obedience to the superior of the order, and to swear that they would faithfully perform the duties that they had taken upon themselves. When the feudal system came into operation throughout Europe, and every landowner was supposed, by a legal fiction, to hold his land from the sovereign as nominal owner of the whole country, every one who possessed land above a certain extent of acreage, or a certain yearly value (*see* Knight's Fee), was obliged to take upon himself the order of knighthood.

and, by doing so, to show that he was possessed of the necessary arms and had received the training requisite to enable him to render effective service to the king in time of war. If any one whose estate was of sufficient value omitted to become a knight, the king was enabled to compel him to do so by process of distress upon his land, taking the whole or part of it from him until he had performed the duties which his fealty to his sovereign demanded. There were certain cases under which exemption from service could be procured by paying a sum of money as a fine to the king. Persons, therefore, who were prevented from becoming knights by bodily infirmity, or any impediment which could be received as a reasonable excuse, were, in the later feudal times, obliged to appear before two commissioners, who arranged the amount to be paid by way of composition for exemption. In the 12th century, several orders were instituted which partook equally of a military and religious nature, those who took the vows being obliged to abstain from marriage like the monks and clergy. Among the most famous of these were the orders of the Knights Hospitallers and Templars, and those of Alcantara and Calatrava. About 180 orders of knighthood have been instituted at various periods since the 6th century, when the order of the Round Table is said to have been instituted by the British king Arthur. Among these are a few orders for females only; such as the Spanish order of Maria Louisa, the Austrian order of the Star of the Cross, and the German order of the Slaves of Virtue. Every European court possesses several orders of knighthood, but they are far more numerous in continental courts than in the court of St. James's, as the English court is styled. The orders of Great Britain and Ireland are those of the Garter and the Bath for England, the Thistle for Scotland, and St. Patrick for Ireland. In addition to these, a new order, named the order of the Star of India, was instituted by Queen Victoria in 1860. This, and the other British orders, are noticed under their respective headings. (*See* BATH, ORDER OF THE GARTER, ORDER OF THE; PATRICK, ORDER OF SAINT; STAR OF INDIA, ORDER OF THE; THISTLE, ORDER OF THE, and CHIVALRY.)

KNIGHT OF THE SHIRE, the designation by which the representative of a county or shire is distinguished from the representative of a borough town, or any city or town which is a county in itself. Knights of the shire were originally paid for their services in parliament at the rate of four shillings a day, during the time that they were obliged to be absent from home in the performance of their duties. The requisite sum of money was raised by a county rate, to which all freehold lands, with a few exceptions, were liable to contribute. Lands which belonged to the clergy, who were represented in parliament by their bishops and mitred abbots, and the nobility who sat in the common house of representatives as lords temporal, were also exempt from contribution to this rate. In former times, persons were as anxious to evade serving in this capacity as they are now emulous of obtaining the honour. At the conclusion of an election, when the state of the poll is declared by the high sheriff of the county, that functionary causes each member to be girt with a sword, and spurs to be buckled on his feet, in token of his election as a knight of the shire. The qualifications requisite to enable any one to exercise the right of voting at an election of a county member, and the disqualifications which prevent any man from sitting in parliament as such, are mentioned elsewhere.

KNIGHT'S FEE (Med. Lat. *feoda*), the term applied to land which was granted by the king, or any nobleman who was possessed of a large extent of territory, to any man and his heirs, on condition that he and they should perform suit and service as a knight in return for the land thus granted, or provide a substitute in case of bodily infirmity or any other hindrance. The extent and estimated value of a knight's fee varied according to its situation and the period at which the grant was made. With regard to the former, the quantity of land that was considered sufficient to enable the holder to support the dignity of a knight varied from 600 to 800 acres, while the yearly value of a knight's fee was estimated at from £15 to £20 during the time of the Norman kings, and was fixed at double that amount in the reign of Edward II.

KNIGHT'S SERVICE, TENURE BY (Lat. *tenere*, to hold), the most general method of holding land in England, from the time of the Conquest to the termination of the civil war. The whole country was supposed to be divided into knights' fees, for each of which the owners of the land were obliged to furnish a knight, completely armed and equipped, for the service of the king in time of war. Thus every noble who owned a great extent of land was obliged to serve the king in time of war, and for a certain period in each year, with as many knights under him as there were knight's fees upon his estate or estates; and such noble became, in turn, the feudal superior of a certain number of knights, who held land under him on the same conditions as the noble himself held his lands from the king; and were obliged to render him suit and service in a similar manner, and in proportion to the extent of land in their occupation. There were, also, other burdens, besides military service, which fell heavily at times on those who held lands by this kind of tenure. The holder of a knight's fee was obliged to pay a sum of money towards the amount required for the ransom of his feudal superior when he was taken prisoner in battle, and towards the expenses that were incurred when his eldest son was made a knight and when his eldest daughter was married. Such payments were termed "aids;" and, in addition to these, the tenant was obliged to contribute when the heir had to pay a composition to the king for leave to enter on the enjoyment of property which had come to him after he had attained his majority. When any heir had inherited land during his minority, his feudal superior became his guardian, and was entitled to the management of his land, and the profits arising therefrom, until the rightful possessor became of age; and he also had a right to demand a sum of money from his ward, whether male or female, in case he or she refused the wife or husband that he might be pleased to select for him or her. Besides these, there were also rights arising from primer seisin, fines upon alienation and escheat (*see* ALIENATION, ESCHEAT), the first of which was the king's right to demand a sum equivalent to a year's profit of the land from any heir who held land direct from the sovereign when he happened to have attained his majority before the land descended to him from his father, or any other relative or connection. This system of tenure was virtually brought to an end during the time of the Commonwealth under Oliver Cromwell, and finally abolished by act of parliament in the reign of Charles II.

KNOT, *not* (*cnotta*, Du. *knot*), a term properly applied to the union of threads or cords by interweaving. Among seamen, however, the word knot also implies a division of the log-line, which bears the same relation to a mile as half a minute bears to an hour. When a ship is said to be going eight knots, for instance, it signifies that she is progressing at the rate of eight miles per hour. (*See* LOG.)

KNOUT, *nowt* (Rus., whip), is the name of the severest judicial punishment inflicted in Russia. The culprit is bound to two stakes, and receives on his bare back the specified number of lashes from a whip of plaited thongs interwoven with wire. From 100 to 120 lashes are the highest number inflicted, and are considered equivalent to a sentence of death. If the criminal survive, he is banished for life to Siberia. Formerly, the nose was slit, the ears cut off, and the letter V (for *vor*, rogue) branded on the forehead; but this aggravation was abolished by Alexander I. Although the punishment is still in use in the Russian army, it is now rarely resorted to, except in the infliction of a small number of lashes, usually from three to ten, and that more with the view of disgracing than of injuring the culprit.

KNOWLEDGE, *nol'-edj* (Lat. *cognitio*, Gr. *gnosis*), according to Locke, "is the perception of the connection and agreement, or disagreement and repugnancy, of any of our ideas." Knowledge is the possession of truth, and may be historical or empirical, philosophical or scientific, or rational. Historical knowledge is so named, because in it we know only the fact—only that the phenomenon is. It is also called empirical or experiential, if we may use the term, because it is given us by experience or observation, and not obtained as the result of inference or reasoning.

In philosophical, scientific, or rational knowledge, we have the knowledge of the cause why or how a thing is. It is the knowledge of effects, as dependent on their causes, and is synonymous with science. The schoolmen divided all knowledge into two species,—*cognitio intuitiva* and *cognitio abstractiva*. By intuitive knowledge, they signified that which we gain by an immediate presentation of the real individual object, by abstractive, that which we gain and hold through the medium of a general term; the one being, in modern language, a perception, the other a concept.

Kobold, *ko'-bold*, a German word signifying a spirit, which differs from the spectre in never having been a living human creature. It corresponds to the English *goblin*, of which it is probably the origin. The kobold is said to be connected with a house or a family, and always to appear in human shape. Among the superstitious peasantry, the kobolds are believed to be inclined to mischief and teasing, but, on the whole, more desirous of doing good than evil to men, except when irritated. In the mines they are believed to appear, sometimes in the form of a blue flame, sometimes in that of a dwarfish child, and to point out rich veins. The miners, however, are afraid of disturbing the underground kobolds. The name of the metal *cobalt* is derived from this word.

Kohinoor, *ko-e-noor'* (Hind. *koh-i-noor*, mountain of light), a large diamond in the possession of the British crown, said to have been found in the mines of Golconda in the middle of the 16th century, which weighed nearly 800 carats in its rough state. It belonged, in turn, to Shah Jehan and the Indian monarchs of the Mogul dynasty, and at last came into the hands of Runjeet Sing, the powerful ruler of the Punjaub. When this territory was annexed to the British empire, the kohinoor, the weight of which had been reduced to 279 carats by the unskilfulness of the lapidary that had been engaged to cut and polish it, was added to the crown jewels, and presented to her majesty in 1850. It formed a feature of interest in the Industrial Exhibitions of 1851 and 1862; but its appearance in each was widely different, as it was recut in 1852 by M. Coster, an eminent lapidary of Amsterdam, who was engaged for the purpose by Messrs. Garrard, to whose care the work was intrusted. The recutting was effected by an apparatus made for the purpose by Messrs. Maudslay and Field, which was driven by a small steam-engine constructed by the same engineers. The lustre and brilliancy of this superb gem, which may be described as conoidal in form, was materially increased by the operation, which occupied several weeks; but its weight was reduced to 147 carats.

Kohl-Rabi. (*See* Brassica.)

Kokum Butter. (*See* Garcinia.)

Kola-Nuts. (*See* Sterculia.)

Kopp's Law, *kops*.—Two laws, the one relating to the proportional connection existing between the atomic volumes of certain liquids; the other to a similar relation observed between the boiling-points of the same substances. A few examples will render this more clear:—

	Atomic vol.		*Diff.*
Formic acid, $HO.C_2HO_3$	522·5	......	—
Acetic acid, $HO.C_4H_3O_3$	797·5	......	275·0
Propionic acid, $HO.C_6H_5O_3$	1067·5	......	270·0
Butyric acid, $HO.C_8H_7O_3$ ...	1347·5	......	280·0
Valeric acid, $HO.C_{10}H_9O_3$ ...	1640·0	......	292·5

From the above table it will be seen that for each difference of C_2H_2 in composition there is a corresponding mean difference of 279·0 in the atomic volume. The same law holds good between the limits of 250 and 300 for the alcohols, the ethyl and methyl compounds, and other organic groups differing in composition in the same degree. The law may be stated in general terms as follows:—That homologous compounds differing by C_2H_2 have a constant difference in their atomic volumes, but that the number expressing differs slightly in different groups; thus, mean difference for the alcohols is 263, for the acids 279, and for the ethers 283. The second law shows the corresponding rise of boiling-point for each increment of C_2H_2, which is, for the acids 36°, for the ethers 44° Fahr., for the alcohols 31·4° Fahr., for the aldehyds 47° Fahr.; and so on. This interesting subject will be found fully discussed in Muller's "Elements of Chemistry," part III. pp. 774—784.

Koran, or **Alcoran**, *ko'-răn* (Arabic, what is read, reading), the sacred book of the Mahommedan religion. All the ethical, civil, political, criminal, and military concerns of the Moslems are regulated by this code. In size it is about equal to the New Testament, and is divided into one hundred and fourteen *suras*, or chapters, each having a title, which states its argument, or beginning with some word contained within the argument, or with an initial letter of such word, declaring also that it was revealed either at Mecca or Medina. The *suras* are divided into *ayats* (signs or miracles), since each contains something wonderful. For the purpose of recitation in the mosques, the Koran is divided into thirty parts, called *adjas*, or into sixty sections named *asalis*, each of four portions. The whole is read daily by thirty readers, appointed on account of their learning. Mahommed began his revelations in the year 610, he being then forty years of age, and continued them during twenty-three years, amid many vicissitudes. There is therefore very little connection between the *suras*, or even between the verses of each *sura*, as they were often promulgated by mere word of mouth, and recorded in the memory of his disciples before being written down. Hence, according to the different occasions on which they were delivered, they contain dogmas, dialogues with Allah (God), narrations, praises of Allah and of Mahommed, rules of conduct for individuals and for society at large, admonitions, defences of the Prophet's doctrines, promises, refutations of slanders, encouragements to the faithful, and threats,—all without any systematic arrangement. The sources of these lucubrations were, in addition to the inventions of the Prophet himself, the ancient traditions of the Arabs, the writings of the ancient Hebrews, the Talmud and Midrash of the later Jews, the Christian New Testament, together with the writings considered as apocryphal, the so-called *protevangelia*, and some of the tenets of the Magi. Many of these elements are modified in various ways. Sometimes they are perverted altogether, and are especially affected by anachronisms. Concerning the mode in which the Koran was written, there are very different opinions among its votaries, as well as among its adversaries. According to the former, the mission of the Prophet was predicted in the Old Testament, which they hold was falsified by the Jews. They hold that the first portions of the Koran were brought from the Seventh Heaven by the archangel Gabriel. Mahommed subsequently received portions at different times at Mecca, and, later still, at Medina. A kind of Lord's Prayer (being universal) forms the *Fatihat* (exordium, opening), or first *sura*. The several portions were either written down, at the Prophet's dictation, on skins, the shoulder-blades of sheep, or on palm leaves, or were merely remembered. The arrangement of the book is said to have been pointed out by the archangel Gabriel, and the collection was preserved in the ark of the doctrine. Mahommed examined the Tenzil (which was said to have been written on the skin of the ram which Abraham sacrificed instead of his son Isaac, bound in silk, and adorned with gold and jewels from Paradise) every year, and inspected it twice in the year of his death. Such is the belief of the faithful, who, however, do not agree in all the traditions. It is claimed by various sects, but not proved, that several persons assisted Mahommed in writing. Many *As'habs*, or disciples of the Prophet, having been slain in the battle of Yemama, Abu-bekr (his father-in-law and first caliph), acting by the advice of Ali, ordered one of his followers to collect in writing all those portions of the revelation which the surviving hearers of the Prophet remembered, and intrusted the whole of the work to Hafsa, one of his widows. As the divergencies in the copies of the Koran caused disputes, especially between the Moslems of Syria and Irak, Othman, the third caliph, aided by the *As'habs*, elaborated seven new copies at Medina, and sent six of them to the cities of Mecca, Yemen, Damascus, Bahrien, Bassorah, and Cufa. The varying copies he had burnt, and was hence surnamed *Jami-el*-Koran, the collector of the Koran. Later there appeared other

copies, varying in the reading, division, and number of verses, of which two of Medina, those of Mecca, Cufa, Bassorah, and the so-called *Vulgata*, are especially worthy of notice. The most renowned interpreter of the Koran was Beidhari, who lived in the 15th century. The dialect of the Koran being very pure, ennobled the Arabic language. The system of writing derived from the Syrian had been adopted in the towns of Hira and Anbari, and hence by the Koraish tribe, shortly before the Prophet, who called himself *Nabi Ommy*, the illiterate prophet, because he learned to write late in life. The language of the Koran is peculiar in many respects,—it is often abrupt, often rough, full of rare forms, has a poetic style, the last verses sometimes rhyming; is full of allusions to past and contemporary events; is highly allegorical, sometimes oracular and mystic. Its graphic style is also inconsistent with strict rules, and more compendious than that used in common transactions. Superstitious veneration has opposed many improvements, both in the phraseology and in the writing; hence have arisen various sects and quarrels among interpreters and grammarians. Soon after the conquest of Irak, Mesopotamia, and Syria, the Koran was copied at Bassorah and Cufa so beautifully, that the older copies were soon forgotten. More slender characters were brought into common use at Bagdad, and much later were introduced into the Koran. The reading of the Koran is regarded by the Mahommedans as a most pious work in itself. It must be read with great precision, and those parts and passages at which the reader must incline or prostrate himself, or perform other ceremonies, are inscribed on the margin. Parts of it are employed as prayers, especially the Fatihat. The reading of some passages is used as a specific remedy . . . certain diseases or misfortunes. The copies of the holy book are kept with the greatest veneration, and their envelope often contains the inscription, "Let none but the pure touch it." There are, probably, manuscript copies of the age of Othman and Ali at Constantinople, Damascus, and Cairo; there are some portions dating from the first century of the Hegira at Copenhagen. The general design of the Koran was to unite the professors of the three different religions then followed in the populous country of Arabia in the knowledge and worship of one God, under the sanction of certain laws and the outward signs or ceremonies, partly of ancient and partly of new institution, enforced by the consideration of rewards and punishments both temporal and eternal, and to bring them all to the obedience of Mahommed as the prophet and ambassador of the Deity. The great doctrine then of the Koran is the unity of God; to restore which point Mahommed pretended was the chief object of his mission, it being laid down by him as a fundamental truth that there never was, nor ever can be, more than one true orthodox religion. Whenever this religion became neglected or corrupted in essentials, God, he asserted, had the goodness to re-inform and re-admonish mankind thereof by several prophets, of whom Moses and Jesus were the most distinguished till the appearance of Mahommed, who is the seal of the prophets, and no other is to be expected after him. The more effectually to enforce this idea, a great part of the Koran is employed in relating examples of the dreadful punishments formerly inflicted by God on those who rejected and abused his messengers, several of which stories, or some incidents of them, are taken from the Old and New Testaments, but many more from the apocryphal books and traditions of the Jews and Christians of those ages. Indeed, few or none of the narratives or incidents in the Koran were invented by Mahommed, as is generally supposed, it being easy to trace the greatest part of them to an earlier period than the age of the Prophet. It is beyond dispute that Mahommed was really the chief author of the Koran, though it is probable that he had assistance in his design from others, particularly from one Sergius, a Nestorian monk, and a Jew named Abdallah Ebn Salam. The Mahommedans, however, deny that the Koran was composed either by their prophet himself or any other person, it being their belief that it is of divine origin. The best works to consult upon the tenets of the Koran are Geiger's "Was hat Mohammed aus der Judenthum auf genommen?" and Gerok's "Versuch einer Christologie des Korans," the latter published at Hamburg in the year 1839.—**Ref.** *The New American Cyclopædia*, by Messrs. Ripley and Dana; *The English Cyclopædia*—Arts and Sciences; and the excellent translation of the Koran by Sale.

KORNTHAL, SOCIETY OF, is the name of a religious community in the kingdom of Wurtemberg, founded by one Hoffmann, a burgomaster of Leonberg. Perceiving that a difference of religious belief led many of the inhabitants to emigrate to other countries, he thought that this would be prevented if dissenters were removed from under the jurisdiction of the Lutheran consistory, and were allowed the free exercise of their own religious worship. In 1819 he obtained a royal court granting relief and toleration to about forty families of dissenters, who bought the lordship of Kornthal, about two leagues from Stuttgart, and formed themselves into a community somewhat after the Moravian model. Their numbers, for a period, rapidly increased. Their mode of worship nearly resembles that of the Protestant churches, and their discipline that of the Moravian Brethren.

KOULSDO. (*See* BRAYLBA.)

KRAAL, *kra'-al*, a Dutch term, signifying stockaded places, within which the dwellings of the Hottentots in South Africa stand. Thus, one kraal can contain several huts. The word is also used in order to denote a large space railed off with strong stakes, into which wild beasts are driven by hunters. The inclosures surrounded by strong palisade-work, into which the elephants are driven in Ceylon, are called **kraals**.

KRAKEN, or **KRAXEN,** *krat'-ken*, a name given in the fabulous epoch of natural history to a sea-monster of enormous size. Bishop Pontoppidan, in his "Natural History of Norway," gives an entertaining, if not very satisfactory and accurate, account of this surprising creature. The term, he says, is applied by way of eminence to the fish otherwise called *horven, soe-horven, ancker-troll*, and *kreuzfisch*, which is the largest sea-monster in the . . . According to the learned bishop, the kraken is round, flat, and full of branches. "The Norwegian fishermen unanimously affirm, and without the least variation in their accounts, that when they row out several miles to sea, particularly in the hot summer days, and, by their situation (which they know by taking a view of certain points of land), expect to find eighty or a hundred fathoms of water, it often happens that they do not find above twenty or thirty, and sometimes less. At these places they generally find the greatest number of fish, especially cod and ling. Their lines, they say, are no sooner out, than they may draw them up with the hooks all full of fish; by this they judge that the kraken is at the bottom. They say this creature causes these unnatural shallows, mentioned above, and prevents their sounding." The account goes on further to state, that when the fishermen, by their lines, found that the water was getting shallow, they knew that the kraken was raising himself to the surface, whereupon they immediately left off fishing, took to their oars, and got away as fast as they could. "When," he continues, "they have reached the usual depth of the place, and find themselves out of danger, they lie upon their oars, and, in a few minutes after, they see this enormous monster come up to the surface of the water. He then shows himself sufficiently, though his whole body does not appear, which, in all likelihood, no human eye ever beheld, excepting in the case of one of the young of this species, which shall afterwards be spoken of. Its back, or upper part, which seems to be, in appearance, about an English mile and a half in circumference—some say more, but I choose the least for greater certainty—looks at first like a number of small islands, surrounded with something that floats and fluctuates like sea-weed. Here and there a large rising is observed, like sand-banks, on which various small fishes are seen continually leaping about, till they roll off into the water from the sides of it. At last several bright points, or horns, appear, which grow thicker and thicker the higher and higher they rise above the surface of the water; and sometimes they stand up as high and large as the masts of middle-sized vessels. It seems these are the creature's arms; and it is said that if they were to lay hold of the largest man-of-war, they would pull it down

to the bottom." These arms are supposed to be tentacula, and the kraken itself to be an enormous polypus. Besides these arms, "the great Creator has given this creature a strong and peculiar scent, which it can emit at certain times, and by means of which it beguiles and draws other fish to come in heaps about it." The young kraken referred to by the bishop seems to have been a young and careless one, which came in among the rocks and cliffs near Alstahoug, in 1680. It appears to have caught hold of some trees standing near the water, and was afterwards found entangled among some clefts of the rocks. From the remarks and conclusions of other naturalists, it seems probable that monsters do exist in the northern seas of which philosophy has not yet dreamed. Mr. Maclean, in 1808, reported that he saw, near the island of Coll, an object which at a distance looked like a small rock. Observing it closely, he saw it elevated considerably, and after a slow movement distinctly perceived that which he believed to be the eye of a huge animal. The monster having seen the boat in which Mr. Maclean was, gave chase, and pursued it till it reached the shore. This animal seems to have had a broad oval head, with a neck somewhat smaller, its shoulders being somewhat broader; from which point it tapered towards the tail, which was mostly under water. Its length was estimated at between 70 and 80 feet, and it seemed to move progressively by undulations up and down. The appearance described by Mr. Maclean bears a close resemblance to the descriptions of the sea-serpent which came from America a few years ago. Whatever the animal may be which gave rise to these descriptions, it seems certain that the animal described by Bishop Pontoppidan cannot be looked upon as a reality. The story probably arose from the observation of floating islands or rocks, only visible at particular times. The young kraken was probably some large sea-monster, the dimensions of which became exaggerated in course of time.

Krupp Gun.—The largest of the Krupp guns is an enormous piece. It was exhibited at the Paris Exhibition of 1867, where it excited the greatest attention and wonder. This gun is made of solid steel, and though styled a 1,000-pounder, it is constructed to fire a shot weighing 1,212 lb., or a shell of 1,080 lb. Its calibre is fourteen inches, and its length seventeen feet. It is furnished with a forged inner tube, and is strengthened with three layers of rings over the powder-chamber, and two layers over the muzzle portion. Like most modern weapons, it is a breechloader. The projectile and charge are inserted at the right side, the wedges having been previously loosened by a screw on the other side, the plug removed by another screw fitted to the front of the rear wedge, and the wedges drawn out, and made to rest upon a bed attached to the left side of the breech. The piece weighs fifty tons, and is mounted on a carriage weighing fifteen tons. The manufacture of this one gun continued without intermission, night and day, for sixteen months, and the cost was £15,750. Krupp's works at Essen, in Prussia, cover 450 acres of ground, and employ 8,000 men. They include 112 smelting, reverberatory, and cementing-furnaces; 195 steam-engines, 49 steam-hammers, 110 smiths' forges, and 318 lathes. The master manufacturer, Herr Krupp, also produces from the same establishment 9-inch guns, throwing a shot of 330 lb. or a shell of 275 lb.; and he has furnished the Russian Government with a number of 11-inch guns. The 9-inch guns he can produce at the rate of one a day. The establishment of Herr Krupp at Essen is not only one of the greatest in Germany, but in the world.

Kreatine. (*See* Creatine.)

Kreatinine. (*See* Creatinine.)

Ktistolatræ, *kis-tol'-ă-tre* (Gr *ktistos*, created), in Eccles. Hist., is a branch of the Monophysites, which maintained that the body of Christ, before his resurrection, was corruptible.

Kumquat. (*See* Citrus.)

Kupfernickel, *kup'-fer-nik-el* (Ger.), a mineral containing 44 parts of arsenic to 56 of nickel (Ni_2As). It occurs in Saxony and other parts of Europe, in company with the ores of cobalt, silver, and copper, and forms one of the principal sources of nickel. It is also found sparingly in Cornwall.

Kussier, *kus-seer'*, a Turkish musical instrument, somewhat resembling the ancient lyre. It consists of five strings, stretched over a skin that covers a kind of basin.

Kuteera. (*See* Sterculia.)

Kyanite. (*See* Cyanite.)

Kyan's Process, *ky'-ăns*, a process for preserving wood, sail-cloth, cordage, and similar materials, by soaking them in a solution containing from 1½ to 2 per cent. of corrosive sublimate. (*See* Antiseptics.)

L.

L is the twelfth letter of our alphabet, and is derived from the old Hebrew *lamed*, or the Greek *lambda*. In the ancient Greek, the Celtic, and the Etruscan alphabets, it is formed by two straight lines making an angle with each other, but sometimes placed horizontally and sometimes vertically. It is one of the four liquids of grammarians (*l*, *m*, *n*, *r*), and is sounded by placing the tip of the tongue against the upper incisor teeth, while the breath issues at its sides, and the larynx vibrates; whence it is called a linguidental letter. In English it is often mute before consonants, as in *could*, *calm*, *psalm*, &c. It is wanting in some languages, as the Japanese, where *r* is used instead. The Romans often put *l* for *r* in words taken from the Greek, as the Italians have done in words taken from the Latin. It also interchanges with *n*, *m*, *d*, *i*, *u*. As a numeral, L denotes 50, and with a dash over it (thus, $\overline{L}$), 5,000.

La, *la*, in Mus., is the monosyllable by which Guido denominated the last sound of each of his hexachords. It answers to the note A in the natural hexachord, and is applied to that note in solfaing.

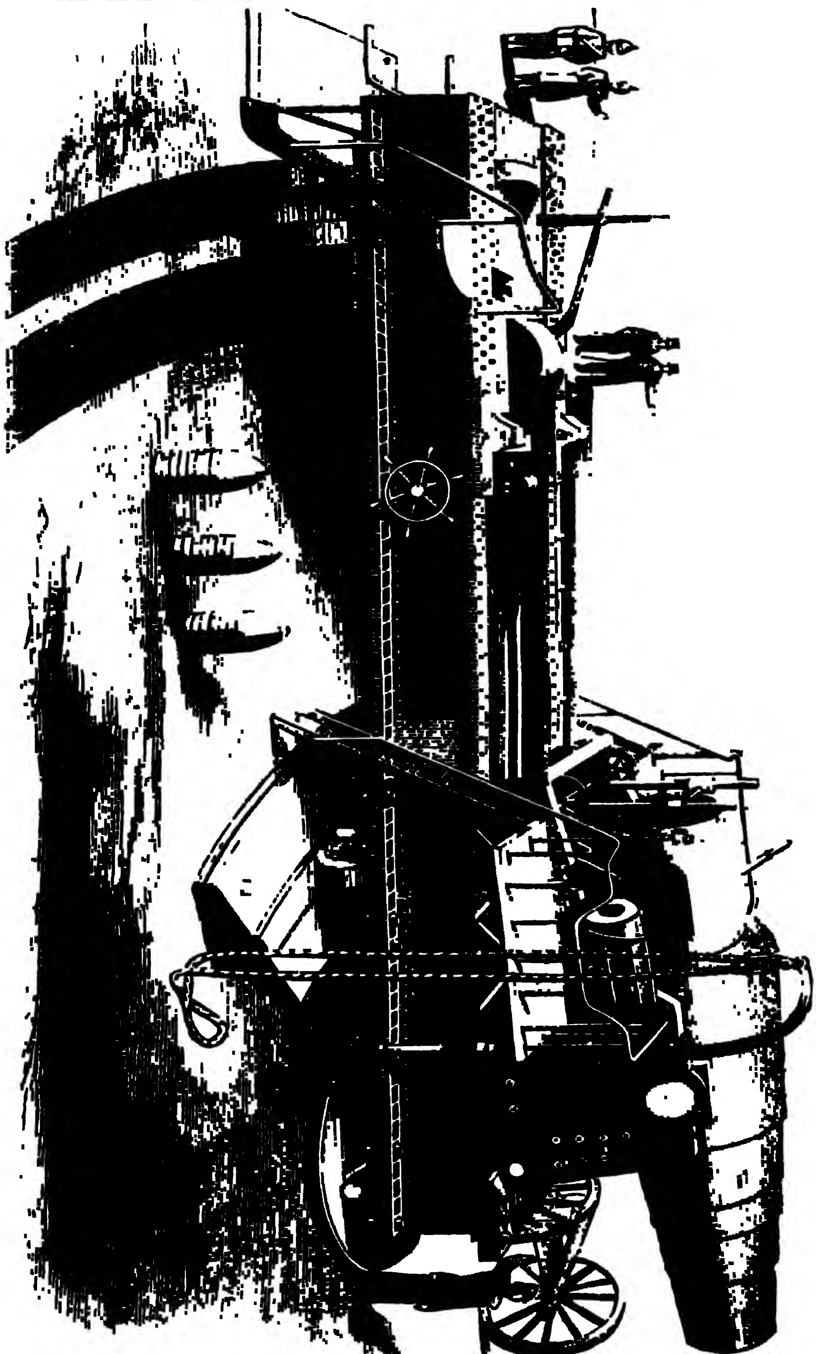
Labadists, *lăb'-ă-dists*, were a sect of religionists, named after their founder, Jean de Labadie, a French mystic. He was originally a Jesuit, but joined the Reformed church, and laboured with acceptance in France, Switzerland, and Holland. Afterwards he propounded a species of mysticism, laying great stress upon the internal light by which alone the outer revelation can be made intelligible, and maintaining that the contemplative life is a state of grace and union with God, and the very height of perfection. He likewise advocated a community of goods. His party assembled first at Middleburg, in Zealand, then at Amsterdam, and then at Hervorden, in Westphalia. They afterwards removed to Altona, where Labadie died, in 1674, and finally to Wiewert. They do not now exist.

Labarum, *lăb'-ă-rum*, the name given to the standard of Constantine, which he adopted in commemoration of the vision of the cross which he had seen in the heavens. It is described by Eusebius as a long gilt spear, with a cross-beam towards the top and a golden crown on the summit, inclosing the two first letters of the Greek name of Christ, intersecting each other, and representing the form of a cross. From the cross-beam was suspended a silken banner, with images of the emperor and his children inwrought into it.

Label, *lai'-bl* (Ang.-Nor.), in Her., a figure, consisting of a fillet, with three or more pendants attached, used chiefly to distinguish the arms of an eldest son during the life of his father; also employed to distinguish them from those of the younger son. The label is considered the most honourable of all differences, and is formed by a fillet generally placed in the middle and along the chief of the coat, without touching its extremities. Its proper width is a ninth part of the chief; when more than three pendants are employed, the number is specified in blazoning.

Labials, *lai'-be-als* (Lat. *labium*, a lip), in Gram., is a term applied to certain letters of the alphabet, on account of their being chiefly formed by the lips. They are *b*, *p*, *v*, *f*, *m*.

Labiatæ, or Lamiaceæ, *lai-be-ai'-te*, *lai-me-ai'-se-e* (from *labium*, a lip), in Bot., the Labiate fam., a nat. ord. of *Dicotyledones*, sub-class *Corolliflora*. Herbs or shrubby plants, usually with square stems. Leaves opposite and exstipulate, commonly strong-scented. Flowers irregular, generally in axillary cymes, which are arranged in a somewhat whorled manner, so as to



The 1,000-pounder Krupp Gun used at the Siege of Paris.

form what are called verticillasters; calyx persistent, corolla more or less bilabiate; stamens didynamous, or, rarely, 2 by abortion; ovary deeply 4-lobed; style 1, basilar; stigma bifid. Fruit containing from 1—4 achænia, inclosed by the persistent calyx. Seeds erect, with little or no albumen. The order is a very large one, comprising 129 genera, or 2,350 species, mostly natives of temperate climates. The plants are altogether free from any deleterious qualities; they abound in volatile oil, and are commonly aromatic, carminative, and stimulant. Several are used in perfumery on account of their sweet odours, as the species of *Lavandula* (lavender) and *Pogostemon* (patchouli); while many are employed in the culinary art for flavouring; as *Thymus vulgaris* (common or garden thyme), *Thymus citriodorus* (lemon thyme), *Salvia officinalis* (sage), *Origanum vulgare* (common marjoram), *Marjorana hortensis* (sweet marjoram), the species of *Mentha* (mint), *Satureja* (savory), and *Melissa* (balm).

LABIATIFLORÆ, *lăb'-be-ăt-e-flor'-e*, in Bot., the name given to a sub-ord. of *Compositæ*, characterized by the division of the hermaphrodite florets, or at least the unisexual ones, into two lips. No important plants belong to this sub-order. A few have aromatic and mucilaginous properties, and one, *Printzia aromatica*, a native of the Cape of Good Hope, is said to furnish a substitute for tea.

LABORATORY, *lăb'-o-ra-to-re* (Lat. *laboratorium*, from *laboro*, I toil), a place for chemical operations, whether intended for scientific research or for manufacturing purposes. The importance of experiments with relation to the science of chemistry cannot be overrated; for although, by the simple observance of nature, the properties of numerous substances can be ascertained, and several forces developed capable of producing chemical changes, still chemistry as a science, both theoretically and practically, mainly depends upon experiment. To the laboratory properly belong nearly all the facts of the science, and all the arts and useful manufactures depending upon it. At first the apartments where the chemist carried on his researches were constructed underground, and all his operations were carried on in a badly-lighted and badly-ventilated room. The reason for this was probably the custom of the alchemists, who seem to have preferred to work in dark, dingy, and unwholesome dens. As impure air and imperfect light were found to be unnecessary for laboratories, they began to be built above ground, and, as a general rule, at the present day resemble other buildings wherein the investigation of science is carried on. A laboratory devoted to scientific purposes ought to be one story in height, in order to facilitate access to the apartments, and to render more easy the bringing in of heavy articles; such as wood, coals, carboys, &c. The same arrangement, also, is favourable for the construction of openings in the roof either for ventilation or skylights. When a laboratory is connected with a theatre or lecture-room, the two are sometimes united in the same apartment, and sometimes divided by a partition. The advantage gained by the former arrangement is, that the furnace operations can be rendered more easy before a class. It has the disadvantage, however, of being too large for private research, and the seats and room generally become soiled and injured by the operations. A laboratory, the apartments of which are distinct, ought to be from fifty to eighty feet in length, and from twenty to twenty-five feet in breadth. There should be plenty of light, both from lateral windows and from skylights. The theatre, or lecture-room, should occupy two-thirds of the length of the building, and the partition which separates it from the working-room, &c., ought to contain the flues from all the furnaces in the building. The flues may be spread over the wall, and gathered together, and carried out of the roof in one large chimney. The floor of the lecture-room before the partition should be of brick or stone to the extent of eight or twelve feet. In front of this, a long table should stretch the full breadth of the building, close to the seats of the class. At the end of the space inclosed by the table should be cupboards with glass doors, for containing the jars of the pneumatic cistern, measures, retorts, flasks, and other apparatus required by the lecturer. The table should be abundantly supplied with drawers of various sizes, for the reception of ordinary substances and re-agents used in demonstration and not requiring to be kept in phials. Amongst these should be the common metals and many earthy and metallic salts. Besides these, other drawers should contain numerous tools, such as knives, gimlets, files, &c., and other indispensable articles, such as glass, corks, stoppers, stirrers, tapers, bladders, matches, sand, tubes, &c. Two or three portable furnaces are usually necessary, and a recess in the partition wall, having a strong draught, in order to carry off pernicious fumes, if any such should result from an experiment. The working-room of the laboratory, on the other side of the partition, may be divided into two compartments, one of the two being double the size of the other. The larger of the two ought to be used as a working-room, and the smaller for containing delicate articles of apparatus, such as balances, electrical machines, air-pumps, &c., which might be injured by the atmosphere and moisture of the working-room. The floor of the working-room should be of brick or stone. Among the fixtures of a laboratory the general working furnace is the most important. Its uses are partly to heat the building, to heat water, to raise a crucible to ignition, and to afford a high temperature to a number of flasks and evaporating-basins by means of a sand-bath. By means of a flat top, covered with layers of sand, this furnace should be able to supply every gradation of temperature, from a dull red heat to that of 100° Fahr., or even lower if necessary. Over the top of the sand-bath should be a large open hood, for the purpose of collecting and conducting to the chimney, the fumes and vapours arising from the evaporating liquids. Near the general furnace there ought to be another furnace for heating a large copper boiler intended for supplying the laboratory with hot water; it should also be provided with a still, in order to furnish distilled water, an absolute necessary in every laboratory. Throughout the apartment there ought to be as much table space as possible. One large table ought to be in the middle, in such a position as to receive plenty of light; it should be strong, covered with sheet-lead to protect it from the action of acids, &c., and should be provided with numerous drawers or cupboards. A stone sink should be constructed in the corner of the room, as much out of the way as possible: it ought to be connected with a cistern or aqueduct, as an abundant supply of water is always required. The pneumatic trough or cistern is a portion of the apparatus which is of great importance: it should be larger than that used in the lecture-room, and capable of holding several jars of gas at once. It should be filled with water to within 1½ or 1¼ inches, and provided with a stop-cock, in order to remove and replace the water when it becomes acidified or foul. The best pneumatic cisterns are made of japanned copper, supported in a wooden frame about 30 inches from the floor. A mercurial cistern is also necessary: it should be made of marble, soap-stone, or cast iron, and mounted on a firm frame. In a laboratory there should always be plenty of cupboards and shelves; the former are useful in protecting preparations and apparatus from the dust which naturally falls and accumulates in the room; and the whole of the walls within reach should be covered with shelves, in order to receive bottles and jars. A tube-rack, for holding glass tubes, from one to three feet long, should also be provided; and a portion of the wall should be furnished with long spikes, on which to hang retort and flask ring-holders, large bent tubes, siphons, coils of wire, iron tongs, &c. Amongst the ordinary apparatus required for chemical experiments in a laboratory may be classed a quantity of filtering-stands, supports for retorts and flasks, wooden forms for holding glass evaporating-basins, flasks, and receivers; and also a great variety of ordinary open furnaces. With these, it is also necessary to have strong wooden blocks, on which to rest heavy mortars; an anvil, a vice fixed to a side-table, several hammers, chisels, and saws; a screw-driver, with various gimlets, bradawls, files, &c.; forceps, a trowel, a soldering-iron, a glue-pot, nails, screws, spatulas of silver, steel, ivory, and wood; a blowpipe, scissors, corkscrew, scratching diamond, &c. Besides laboratories intended for scientific research, there are others which are devoted to articles

of chemical manufacture; as the alkaline, earthy and metallic salts, pigments, &c. In all these cases, however, the processes of manufacture differ so greatly that the laboratories of each have to vary according to the nature of the process. In military language, the term laboratory is that place where fireworks, both for actual service and experiments, are prepared.—*Ref.* Faraday's *Handbook of Chemical Manipulation.*

LABOUR, *lai'-bor* (Lat. *labor*), in Pol. Econ., is defined to be "the voluntary exertion of bodily or mental faculties for the purpose of production."—(*Senior.*) Nature spontaneously furnishes the matter of which commodities are made; but, independently of labour, matter is seldom of much use, and is never of any value. "Labour was the first price, the original purchase-money, that was paid for all things. It was not by gold or by silver, but by labour, that all the wealth of the world was originally purchased." (*Adam Smith.*) The progress of the human race, at different times and in different countries, has generally been pretty much in proportion to their expertness in appropriating the raw products of nature and adapting them to their use. "Labour," says McCulloch, "is the talisman that has raised man from the condition of the savage, that has changed the desert and the forest into cultivated fields, that has covered the earth with cities and the ocean with ships, that has given him plenty, comfort, and elegance, instead of want, misery, and barbarism." Labour is not creative of objects, but of utilities. All the labour in the world could not produce one particle of matter; it can only change what is useless into what is useful to man. The utilities produced by labour are, according to J. S. Mill, of three kinds.—"First, utilities fixed and embodied in outward objects, by labour employed in investing external material things with properties which render them serviceable to human beings: this is the common case, and requires no illustration. Secondly, utilities fixed and embodied in human beings, the labour being, in this case, employed in conferring on human beings qualities which render them serviceable to themselves and others: to this class belongs the labour of all concerned in education, not only schoolmasters, tutors, and professors, but governments, so far as they aim successfully at the improvement of the people; moralists and clergymen, as far as productive of benefit; the labour of physicians, as far as instrumental in preserving life and physical or mental efficiency," &c. "Thirdly, and lastly, utilities not fixed or embodied in any object, but consisting in a mere service rendered, a pleasure given, an inconvenience or a pain averted, during a longer or a shorter time, but without leaving a permanent acquisition in the improved qualities of any person or thing, the labour being employed in producing a utility directly, not (as in the two former cases) in fitting some other thing to afford a utility; such, for example, is the labour of the musical performer, the actor, the public declaimer or reciter, and the showman." Some good, or it may be evil, may be produced beyond the moment, but it is the immediate pleasure that is the effect intended. (*See* POLITICAL ECONOMY.)

LABOURING, *lai'-bor-ing* (from Lat. *laboro*, I toil), in nautical language, a term applied to a ship when she does not answer her helm readily in a heavy sea, but jerks or yawns from side to side in a restless and uneasy manner.

LABRADOR TEA. (*See* LEDUM.)

LABRADORITE, *lăb'-ră-dor-ite*, a silicate of alumina and lime, with certain admixtures of soda and iron. It receives its name from having been first found in Labrador. It is much valued as an ornamental stone, in consequence of the beautiful opalescent blue, or golden brown, lustre reflected from it when held in certain positions, owing to its translucency and nacreous structure.

LABYRINTH, *lăb'-e-rinth* (Lat. *labyrinthus*), is a place, usually underground, with numerous and intricate passages, which it is impossible to traverse without a clue. Three famous labyrinths are mentioned in ancient history. The earliest and most renowned was that of Egypt, situated at Arsinoe, near Lake Mœris. Herodotus visited and describes it. It had 3,000 apartments, 1,500 underground and the same number above it, the whole being surrounded by a wall. It was divided into courts, each of which was surrounded by colonnades of white marble. It was extant in the time of Pliny. Ruins at the modern village of Howara, in Fayoom, have recently been identified with those of the labyrinth. The second labyrinth was that of Crete, in the neighbourhood of Cnossus, said to have been built by Dædalus, at the command of King Minos, as a place of confinement for the monster Minotaurus. It was built on the model of that of Egypt, but on a much smaller scale. None of the ancient authors who have left accounts of it seem to have seen it, and no traces of it are now to be found; hence modern writers generally deny its existence. A third labyrinth was that in Lemnos, commenced by Smilis, an Æginetan architect, and completed by Rhœcus and Diodorus of Samos, about the time of the first Olympiad. It was similar in structure to the Egyptian, from which it was distinguished only by a greater number of columns. Remains of it were still extant in the time of Pliny. A similar structure was said to exist on the island of Samos, but no particulars of it are known.

LABYRINTH, in Anat. (*See* EAR.)

LAC, *lak*, a Hindostanee term, which, in its original acceptation, is applied to the computation of money in the East Indies. Thus, a *lac of rupees* is equal to 100,000, and, supposing them to be standard (*siccas*), equivalent to £12,500.

LAC-DYE and RESIN (Dan. *lak*, said to be from the Arabic).—Lac is a resin which exudes from the branches of several trees in tropical climates, particularly from the *Ficus religiosa*, *Ficus indica*, and *Rhamnus Jujuba*. The resin is formed in consequence of the punctures made in the bark of the tree by the female of a small insect of the cochineal tribe, the *Coccus ficus*. The resinous juice which exudes hardens over the insects, fastening them to the twigs, which, when cut off, constitute the *stick-lac* of commerce. The crude stick-lac is bruised, the fragments of the twigs removed, and the resin digested in a weak solution of carbonate of soda. The alkaline solution dissolves out a red colouring matter, known as lac-dye. The residue, which is insoluble in the alkaline lye, forms the *seed-lac* of commerce. *Lac-dye* is now extensively used in lieu of cochineal for dyeing scarlet. The pinks produced by it are, however, inferior. *Seed-lac*, when melted, forms *shell-lac*, which is used for various varnishes, as a stiffening for hats, and as the principal ingredient in sealing-wax. Mixed with half its weight of sandarach and a small quantity of Venice turpentine, and dissolved in alcohol, it forms *lacquer*, a varnish much employed to heighten the colour of brass and bronze, and protect these alloys from tarnishing.

LAC SULPHURIS (Lat., milk of sulphur).—Sulphur precipitated from solutions of alkaline persulphides by the addition of an acid, was formerly used in medicine under this name.

LACE, *lais* (Lat. *lacinia*, the hem or fringe of a garment), a term properly signifying a network of gold, silver, flax, or cotton threads, forming a transparent texture. The origin of this delicate fabric is not known, but it appears to have been worn by the Grecian and Roman ladies. At Venice it was early in use, and it is said that Mary de Medici was the first to introduce it into France from Italy. In England, from a prohibition, in 1483, of the importation of foreign lace, the manufacture would seem to have been established there prior to that date. But as pins, which are required in lacemaking, were not used in England till 1543, the lace produced must have been of a coarse kind. The lace-manufacture is said to have been introduced into this country by some refugees from Flanders, who settled at Cranfield, in Bedfordshire. In 1640, the weaving of lace had risen to the position of a flourishing trade in Buckinghamshire, and twenty years later a royal ordinance was passed, establishing a mark on the thread-lace exported from this country. The original manufacture was called *pillow* or *bobbin lace*, and was usually made of thread or silk, woven into net with hexagonal, octagonal, &c., meshes. Afterwards it was ornamented with a thicker thread, called *gimp*, so interwoven with the meshes as to form flowers or curved designs. Lace of this kind was made on a hard-stuffed pillow or cushion, covered with parchment, on which the pattern was drawn. Each

thread was wound upon a bobbin, and, to form the meshes, pins were stuck in the cushion, and the threads woven or twisted round them. The spots for the insertion of the pins were indicated by the pattern, and also showed the place for the insertion of the gimp. As many as from 50 to 60 bobbins are required for every inch of breadth, and only one mesh can be made at a time. A piece of lace, one inch wide, with 50 threads per inch, will have 25 meshes in the breadth, or 625 meshes in each square inch of length, or 22,000 meshes in the yard; while the cost of such a piece is seldom more than 1*s*. 8*d*. The most celebrated laces are,—1. *Brussels lace*, a hexagon mesh, the most valuable, which is divided into two classes,—*Brussels ground*, which is made of flax threads, and *Brussels wire ground*, which is made of silk. The pattern is worked separately in both these cases, and set on by the needle. 2. *Mechlin lace*, a hexagon mesh of three flax threads twisted and plaited to a perpendicular line or pillar, with the pattern worked in the net. 3. *Valenciennes lace*, an irregular hexagon, formed of two threads, partly twisted, and plaited at the top of the mesh, with the pattern worked in the net. 4. *Lisle lace*, a diamond mesh, formed of two threads plaited to a pillar. 5. *Alençon lace*, also called *blond*, a hexagon mesh of two threads twisted similarly to Buckingham lace, and considered the most inferior of any cushion-made lace. 6. *Alençon point-lace*, formed of two threads to a pillar, with octagon and square meshes alternately. In the portraits painted by Vandyke during the reign of Charles I., and also in those painted afterwards by Sir Peter Lely and Sir Godfrey Kneller, the lace represented is *Brussels point*, in which the net-work is made on the cushion with bobbins, and the pattern worked into the net with the needle. About 1777, a new ground was attempted by the lacemakers of Buckingham, which quickly superseded all others: this was the point-ground, which had, it is believed, been imported from the Netherlands. From the first appearance of this ground the origin of the modern pillow-lace trade may be dated. It was not, however, till the beginning of the present century that the most striking improvements were made. After 1812, at Honiton, the manufacture had arrived at that perfection, was so tasteful in design and delicate in workmanship, that the best specimens of Brussels lace did not excel it. During the war with France, veils of Honiton lace were sold in London at from 20 to 100 guineas. After that time, however, the effects of the competition of machinery began to be felt; and gradually the pillow-lace trade sank into insignificance. Lace is said to have been manufactured by machinery as early as 1768, by a stocking-weaver of Nottingham, named Hammond. Various other attempts in the same direction were made about the same time, and a few years afterwards the *warp-frame* for making *warp-lace* was invented. The invention of this machine has been ascribed to four persons,—Vandyke, a Dutchman; Mr. Clare, of Edmonton, near London; Mr Marsh, Moorfields, London; and Mr. Morris, of Nottingham. By these machines lace of an inferior kind was produced in large quantities, and Nottingham became the centre of the new trade. In importance, however, it was soon far eclipsed by the bobbin-net manufacture. In 1809, Mr. Heathcote, of Tiverton, took out a patent for a machine for making bobbin-net lace. This invention made a complete revolution in the manufacture of the fabric. From that time, the machine became the subject of frequent improvement, and was worked by steam-power in 1816. Lace became a general article of consumption, and that which had been sold at five guineas a yard fell to 1*s*. 6*d*. Instead of smuggling French lace into England, English lace was smuggled into France, until the French makers were obliged to use machines themselves. The quality of bobbin net lace depends upon the smallness of the meshes, their equality in size, and the regularity with which their hexagonal shape is displayed. At the present time its manufacture is largely carried on in France, having been established, by English workmen in Calais in 1817, at which town there are now 600 machines. Bobbin-net lace may be said to surpass every other branch of human industry in the complex ingenuity of its machinery.

LACE-BARK. (*See* LAGETTA.)

LACERTA, *lă-ser'-tă* (Lat. *lacerta*, a lizard), a constellation in the northern hemisphere, named by Helvetius. It is situated between the constellations Andromeda, Perseus, Cygnus, and Cepheus, and contains no star above the fourth magnitude.

LACERTINIDÆ, *lă-ser-tin'-e-de* (Lat.), the Lizard fam.—Under this title is included a family of reptiles belonging to the order *Saura*, and characterized by having a round and very elongated body, the tail especially long, being sometimes four times the length of the trunk; four strong feet, with four or five unequal toes, armed with hooked claws; a quadrangular flat head covered with horny plates, and eyes furnished with a membranous expansion, resembling a third eyelid; a wide mouth, and a long, flat, forked tongue. Although they are usually found in the Old World, a small number of species is found in Australia. The *Lacertinidæ* correspond with the genus *Lacerta* of Linnæus. They are very nimble in their movements, springing from one spot to another with great alacrity, and cling to and creep along rocks or walls with facility by means of their hooked claws. In their habits they are gentle and timid, and they live in holes in the sand. They are not sociable in their habits, but live in pairs. Great heat or great cold renders them torpid; and their general food consists of insects, worms, small mollusca, &c. The females lay between five and seven eggs, which they leave to be hatched by the warmth of the air. Some of the species are, however, viviparous, and the whole family is long-lived. The scaly lizard, *Zootica vivipara*, a native of England, is said to hatch its eggs within its own body if it be kept in a dry place, but to deposit eggs if retained in a damp one. The most common species of the *Lacertinidæ* is the green lizard, *Lacerta viridis*, which is from 10 to 15 inches long, of a rich and varied green colour, with spots and marks of brown and yellow. It is an active animal, feeding upon insects, and pursuing them with great agility. When the tail is broken off, the green lizard has the power of forming a new one. It is found in all the warmer portions of Europe and Asia Minor, and has been met with as far north as the Channel isles.

LACHES, *lăsh'-ez* (Fr. *lâcher*, to loosen), in Law, denotes slackness or negligence. The law shows no favour to those that are tardy or negligent, and throws upon the party guilty of it its consequences. It is laid down as a general maxim, that no laches or negligence shall be imputed to an infant; but this is chiefly true of the exemption that he enjoys from the ordinary bar by lapse of time. The law in general is, that, in the case of the sovereign, there can be no laches or negligence. This was formerly absolutely the case; but in certain respects it has been limited by statute. Thus, by 9 Geo. III. c. 16, the crown is barred from its civil rights in suits relating to landed property, by the lapse of sixty years, and by 7 Will. III. c. 3, an indictment for treason (except for an attempt to assassinate the sovereign) must be found within three years after the commission of the offence.

LACHRYMÆ CHRISTI, *lak'-re-me kris'-ti* (Lat., tears of Christ), a name given to one of the best of the wines grown in Italy. It is of a dark red colour, and some critics say, of exquisite flavour. It is grown at Galitta, in Naples, although an inferior quality is grown around Vesuvius, which is exported as the genuine wine. The Lachrymæ Christi is said to be identical with the old Falernian wine frequently mentioned by Horace.

LACHRYMAL, *lăk'-re-măl* (Lat. *lacryma*, a tear), is a term applied, in Anat., to various organs in the neighbourhood of the eye, and connected with the tears; as the lacrymal glands by which they are secreted, and the lacrymal duct by which they are conveyed away. (*See* EYE.)

LACHRYMATORY, *lăk'-re-mă-to-re*, is a small vessel of glass or earthenware, generally having a long neck, and found in the tombs of the ancients. It was long the opinion of antiquaries, that these were intended to hold the tears of the relatives and friends of the deceased; but there is no ground for such an opinion; and it is more generally held now, that they were used for the purpose of containing perfumes.

LACISTEMACEÆ, *las-sis'-te-mas'-se-e*, in Bot., the *Lacistema* fam., a nat. ord. of *Dicotyledones*, sub-class

Monochlamydeæ. ....ts, with simple alternate stipulate leaves and ...owers in axillary catkins. They are natives of woody places in tropical America. Nothing is known of their properties and uses.

LACONISM, *läk'-o-nizm*, in Lit., is a short, pithy, and pointed saying, for which the ancient Lacedæmonians were remarkable; whence the name (from *Laconia*). One of the most remarkable of the ancient laconisms was that of the Spartan mother to her son, on presenting him with his shield—"With it, or on it,"—either bring it back or be carried back upon it.

LACQUERING. (*See* JAPANNING.)

LACTEALS, *läk-te-äls* (Lat. *lac*, milk), in Anat., is the name given to certain vessels of the human body, on account of their containing a milk-like fluid, the chyle. They serve to convey the chyle, or nutritious part of the food, from the intestines to the thoracic duct. They are very tender and transparent vessels, and are furnished with an infinite number of valves. They have their origin in the internal vellous coat of the small intestines, perforate the other coats, and then proceed through numberless converging branches between the layers of the mesentery, to the thoracic duct, the main branch of the absorbent system, which, at the part where the chief lacteal branches join it, is dilated into what is called the receptaculum chyli. In their passage through the mesentery, the lacteals traverse numerous mesenteric absorbent glands, where they communicate with veins, and the fluid contained in them is exposed to the influence of the blood, from which it acquires colouring matter and fibrin. (*See* DIGESTION.)

LACTIC ACID, *läk'-tik* (from Lat. *lac*, milk), ($2HO, C_{12}H_{10}O_{10}$).—Lactic acid is produced by natural or artificial fermentation from milk and other animal matters containing lactose, or sugar-of-milk. Starch, cane sugar, dextrin, and gum, also pass into lactic acid under certain circumstances. Thus it is formed in *sauer-kraut*, in malt vinegar, and during the manufacture of wheaten starch. It is easily made by dissolving 8 parts of cane sugar in 50 of water; to this solution are added 1 part of casein, or poor cheese, and 3 parts of chalk. The mixture is set aside in a warm place for two or three weeks, during which time the mass becomes gradually filled with crystals of lactate of lime. These crystals are purified by recrystallization, and treated with their exact equivalent of sulphuric acid. The residue is digested in alcohol, which dissolves the lactic acid and leaves the sulphate of lime. The lactic acid is obtained from the solution by evaporating the alcohol. In its pure state it forms a transparent, inodorous, uncrystallizable, syrupy liquid, with a sharp acid taste. It is soluble in water, alcohol, and ether, and may be distilled unchanged if air be excluded. Exposed to a heat of 266°, it loses water, and is converted into a yellow bitter fusible substance, nearly insoluble in water. Heated to 500° Fahr., it changes to a volatile acid, the citraconic, and *lactide* distils over. Lactide dissolves in alcohol, crystallizing from it in brilliant rhombic prisms. At 225° it fuses, and may be sublimed unchanged. Dissolved in water, it assumes four equivalents of that substance, and becomes converted into hydrated lactic acid. Lactide absorbs ammonia with great greediness, forming *lactamide*. The lactates are mostly soluble in water; a few of them may be crystallized. Lactic acid enters into the composition of the gastric-juice, the perspiration, and, in cases of diabetes, of the saliva and the urine.

LACTIN, LACTOSE, sugar-of-milk. (*See* SUGARS.)

LACTOMETER, *läk-tom'-e-ter* (Lat. *lac*, milk; *metrum*, a measure), an instrument used for the purpose of ascertaining the proportion of cream contained in the milk of any particular cow, or of the general produce of a dairy. It is generally in the form of a glass tube set perpendicularly in a stand. The tube is about a foot high and half an inch in diameter, with a graduated scale marked on the outside. Milk fresh from the cow is poured into it, and allowed to remain in it till the cream separates and floats on the surface, when, by observing the marks on the scale, the proportions of milk and cream can easily be ascertained.

LACTONE, *läk-tone*, a volatile liquid, with a strong pungent odour, boiling at about 198° Fahr., found amongst the products of distillation of sugar-of-milk.

LACTUCA, *läk-tu'-kä* (Lat. *lac*, milk, from its milky juice) in Bot., the Lettuce, a gen. of the nat. ord. *Compositæ*. The species *L. sativa* is the common or garden lettuce, so largely cultivated as a salad. *L. virosa* is the wild or strong-scented lettuce. If the stem of the common lettuce, when it is coming into flower, be wounded with a knife, a milky juice exudes, which dries in the open air into a friable mass of a brown colour. This inspissated juice is called *lactucarium*, or *lettuce-opium*, and is sometimes employed in medicine for its narcotic properties. *L. virosa* yields the best and the largest quantity of lactucarium. Professor Johnston says,—"The lactucarium is one of those narcotics in which many of us unconsciously indulge. The eater of green lettuce as a salad takes a portion of it in the juice of the leaves he swallows; and many, after this is pointed out to them, will discover that their heads are not unaffected after indulging copiously in a lettuce salad. Eaten at night, the lettuce causes sleep; eaten during the day, it soothes and calms, and allays the tendency to nervous irritability. And yet the lover of lettuce would probably take it very much amiss if he were told that he ate his green leaves partly, at least, for the same reason as the Turk or Chinaman takes his whiff from the tiny opium-pipe."

LACTUCARIUM, or LETTUCE-OPIUM. (*See* LACTUCA.)

LADANUM (*See* CISTACEÆ.)

LADDER, *läd'-der* (Ang.-Sax.), a simple contrivance which affords means of access to any part of the exterior of a house, or from one level to another. In the former case, and in all constructive and decorative operations, painting, glazing, &c., movable ladders are used; but in gaining access from one part of a mine to another, or from the ground-floor of a warehouse or factory to the floors above, fixed ladders are used. Ladders answer the purpose of a staircase in all cases; but in ascending and descending it is necessary to hold the sides of the ladder with the hands, as very few could manage to retain their footing on the rounds without doing so. The ladder consists of two vertical pieces or sides, generally made of a fir pole sawn down the middle, and a number of rounds or transverse pieces of oak, or some hard wood, the ends of which are inserted into holes bored laterally into the sides for their reception, about ten or twelve inches apart. The rounds are fastened and kept in position by wedges that are driven into a slit made in either end of each round. The holes in the sides should be bored before the pole is sawn asunder. The sides of the better kinds of ladders are made of pieces of deal squared and planed; but when fir poles are used, the flat part of the side is generally turned outwards. The rounds vary from an inch to an inch and a half in diameter in the middle, and are rather less in size at either end. An iron bar, with a nut and screw at either end, is generally substituted for a wooden round at a short distance from the top and bottom of a ladder, to lock the whole tightly together. The companion-ladders of ships, and ladders in mills and factories, from one deck or floor to another, have flat heads instead of rounds, and a handrail at the side. They are, indeed, more like a staircase, or a set of steps such as are used by painters, paperhangers, and upholsterers, than a ladder properly so called. A ladder may be made available in gymnastic exercises for strengthening the arms, by placing it against a wall, at any angle between 30 and 45 degrees, and endeavouring to ascend and descend underneath the ladder by clasping the rounds hand over hand. The ladder may also be suspended horizontally for the same purpose, either end being supported on a wall about 8 or 10 feet in height.

LADING, BILL OF. (*See* BILL OF LADING.)

LADY, *lai'-de*, a term supposed to have signified originally loaf-giver (Goth. *hlaif*, loaf, and *dian*, to serve or distribute), from the practice of the wives of the rich distributing bread to the poor or to their domestics. Tooke derives it from *hlifian*, to lift, one raised to the rank of her husband. As a title of honour, it is the correlative of lord. It belongs, of right, to the daughters of all peers above the rank of viscount, and is extended by courtesy to the wives of baronets and knights. In common usage, the term is employed in speaking of the women of the upper classes generally.

Lady-bird, or **Lady-cow**, a well-known little insect, belonging to the family *Coccinellidæ*, which comes under the class of *Coleopterous insecta*, according to Linnæus. The lady-bird is distinguished by a hemispherical and convex form of body, by the second joint of the tarsi being large and deeply bilobed, and by the colour of the spots on the elytra. Different species are found in various parts of the world, and in England it is common enough. The lady-bird is a very small insect, and its colour is generally red or yellow, with black spots, which vary both in size and number, or it is sometimes black, with white, red, and yellow spots. It creeps very slowly, but flies rapidly; and, when alarmed or caught, it ejects a yellow mucilaginous fluid of a strong disagreeable odour. This insect is very abundant in gardens troubled with *aphides* or plant-lice, which it is very useful in destroying, in hop plantations, particularly, it is mostly seen. The young lady-birds are grubs of a small flattened appearance, which are produced from little yellow eggs, which the parent insect deposits among the *aphides*, so that, as soon as they are hatched, they are at once within reach of their prey, which they are easily able to destroy.

Lady-day. (*See* Annunciation.)

Læmodipoda, *le-mo-dip'-o-da* (Gr. *laimos*, throat, *pous*, a foot), the name of an order of *Crustaceans* placed by Latreille between the *Amphipoda* and the *Isopoda*. The head of this order is confluent with the first segment of the thorax, and supports the two anterior feet. They are described by Latreille as being the only form among the *Malacostraca* with sessile eyes, whose posterior extremity does not present distinct tracheæ, and which have hardly any tail. The *Læmodipoda* have all four setaceous antennæ, carried on a three-jointed peduncle; mandibles without palpi, a vesicular body at the base of four pair of feet at least, beginning with the second or third pair, reckoning those of the head. The body, usually filiform or linear, is composed of eight or nine joints, and the feet are terminated by a strong hook. The eggs of the female are carried in a pouch formed by approximate scales, under the second and third segments of the body. All the species are marine. Among the subdivisions are the *Filiformia*, which keep among the marine plants and sponges, walk like caterpillars, turn frequently and rapidly on themselves, or set up their bodies while their antennæ continue to vibrate. The subdivision *Cyamus* has three species, all of which live on the *cetacea*; and one of them, *Cyamus ceti*, is also found on the mackerel. It is called, by fishermen, the whale-louse.

Lagenaria. (*See* Gourd.)

Lagetta, *lag-get'-ta* (*lagetto* is the name of the species in Jamaica), in Bot., a gen. of the nat. ord. *Thymelaceæ*. The species *L. lintearia* is the celebrated lace-bark tree. The bark, when macerated, may be separated into laminæ, the number of which depends upon the age of the specimen: these have a beautiful lace-like appearance, and possess great strength. It may be used for making ropes, and was at one time in great demand in the West Indies for making slave-whips. Sloane says that caps, ruffles, and complete dresses for ladies, have been made from the lace-bark. Lagetta cloth has been imported into this country under the name of *guana*.

Lagoon, *lă-goon'* (Ital. *laguna*, Lat. *lacuna*, a morass), a name applied to extensive creeks which run far inland, and are nearly encircled by the land. In the Adriatic there are many instances of them, as also along the coast of America and amongst the West-Indian islands.

Laird, *laird* (Sax. *hlaford*), is a term used in the Scottish dialect, and properly signifies the lord of a manor, a proprietor holding his lands immediately of the crown:—

> "A laird and twenty pence pronounced with noise,
> When construed, but for a plain yeoman go."

It is in common language used in a much wider sense, and applied to any proprietor of lands or houses.

Laity, *lai'-e-te* (Gr. *laos*, the people), is a term applied collectively to the whole people that are not clergy, or not in holy orders. (*See* Clergy.)

Lake, *laik* (Lat. *lacus*), a term applied in Geog. to a quantity or collection of water surrounded by land. Lakes may strictly be divided into four distinct classes:—Firstly, those which neither have an outlet, nor receive any addition to their contents from running water; secondly, those which have an outlet and are fed by springs, receiving no superficial running water; thirdly, the class which is by far the most numerous, that both receive and discharge streams of water; and, lastly, those which receive tributaries, but have no visible outlet or communication with the sea. Of these latter, the Caspian Sea and Lake Aral are instances. It is, however, remarkable that all lakes of this description are found to be salt. There are many peculiar phenomena connected with lakes which are wholly unaccounted for. Among the rest, the faculty of disappearing, and reappearing again at intervals; as Lake Chirtunitz, in Illyria, and also Lake Welter, in Sweden, which experiences violent agitations during severe weather.

Lake Iron-ore.—Hydrated peroxide of iron is deposited in large quantities by certain lakes in Sweden and Norway. It is similar in composition to the bog iron-ore found in other parts of Europe.

Lakes, insoluble compounds formed between the colouring matters of dye-stuffs and hydrate of alumina and other metallic oxides. The process of mordanting depends on this property. By soaking the fabrics to be dyed in a solution of a salt of alumina, binoxide of tin, or the sesquioxides of iron and chromium, a union takes place between the fibre and the salt; when the fabric is passed through the dye-stuff, an insoluble lake is formed in the fibre of the cloth. It is generally supposed that the lakes are insoluble precipitates, formed between the metallic oxide and the acid of the dye-stuff. Numerous lakes thus formed are made into pigments, the names of which indicate their origin.

Lama, Lamaism, *la'-ma, la'-ma-izm* (Thibetan *lama*, a priest), is the name of the prevailing religion of Thibet and other parts of Asia. It is an offshoot of Buddhism, which it very much resembles. The Dalai Lama, or chief of this religion, is the [illegible] nded incarnation of Buddha. He is looked upon as an omniscient and eternal divinity; and hence his death occasions no visible grief or mourning, as it is only regarded as his disappearance, and his reappearance is patiently waited for in his successor. The Dalai [illegible] times points out his successor; at other times the [illegible]s are consulted for that purpose. When officiating, the Dalai sits cross-legged and statue-like upon magnificent cushions over the altar, dressed in splendid robes, noticing nobody, and moving only his hands to bless the people. Sometimes he distributes balls made of paste, clay, or other materials, which are regarded of infinite efficacy. The title of lama is given to the head of every monastery, and every lama is considered a vicar of the Deity, and requires implicit obedience to all his commands, like the Dalai Lama himself. Their temples are in the Indo-Chinese form, square, fronting the east in Thibet and the south in Mongolia. They have three gates and three interior divisions; viz., the entrance-hall; the body of the edifice, with two parallel rows of columns, and the sanctuary, with the throne of the high lama. There are numerous statues, paintings of the gods, ornaments, and implements of all sorts. The walls and columns are inscribed with prayers, and there are also poles bearing flags with prayers. Prayer-wheels, the turning of which is supposed to be equally efficacious with vocal supplication, are to be seen everywhere. Festival days, ceremonies, and pageants of all kinds, varied with the performances of magicians, as well as fasts, sacraments, and noisy music, animate the zeal of the faithful. Dead lamas are commonly embalmed and preserved in pyramids. The bodies of rich laymen are burned, and their ashes preserved; while those of the common people are either exposed to be devoured by birds, or eaten by sacred dogs kept for the purpose. Rich persons about to die are assisted by lamas, who open a passage for the soul through the skull. The principal holy place in Thibet is Lassa, in and around which are an immense number of monasteries. The most renowned of the Lamaic schools is that of the Lhabrang, or cathedral of Lassa. In many of the monasteries are also schools of magic. The lamas also act as physicians, effecting

their cures by prayers and some innocent medicaments. —*Ref.* Huc's *Souvenirs d'un Voyage dans la Tartarie, le Thibet, et la Chine, pendant les Années* 1844-45-46; K. F. Koeppen's *Lamaische Hierarchie*, &c. (Berlin, 1859); *New American Cyclopædia*.

Lambdoidal Suture, *lam-boy'-e-dăl*, in Anat., is the suture that unites the occipital to the two parietal bones of the skull, and is so named from its resemblance to the Greek letter *lambda*.

Lambeth Articles, *lăm'-beth*, in Eccl. Hist., is the name given to certain articles drawn up by the archbishop of Canterbury and the bishop of London, at Lambeth, in 1595. They are decidedly Calvinistic in their form, but they were never imposed by authority. They are to the effect that God hath, out of his good pleasure, from all eternity, predestinated certain persons to life, others to inevitable condemnation; a true believer is one who is endowed with justifying faith, which faith doth not utterly fail nor vanish away in the elect, no man is able to come to Christ unless the Father draw him, and all men are not drawn by the Father, that they may come to the Son.

Lamb's Lettuce. (*See* Valerianella.)

Lamellæ, *la-mel'-le* (Lat.), a term applied in Conch. to those little plates of which the shells borne by crustaceous fishes are composed.

Lamellicornes, *lă-mel-li-korns* (Lat. *lamella*, a plate; *cornu*, a horn), one of the sections of the order *Coleoptera*, according to the system of Latreille. They have five joints to all the tarsi. The antennæ are inserted in a small hollow in front of the eyes, always short, and usually composed of 9 or 10 joints, the last of which are large and flat, and open out like a fan. The clypeus is generally very large, and the labrum small and hidden beneath it. The mandibles of several are membranous—a character observed in no other coleopterous insects. The family is numerous, and is noted for the brilliancy of the metallic colours which ornament those species which feed on living vegetables. The larva is soft, somewhat cylindrical in form, with a large vertical head. Six small legs are attached to the thoracic segments, and the body is always bent. Some of them require three or four years to become pupæ. When about to assume the pupa form, the larvæ inclose themselves in an oval case, or one resembling an elongated ball, composed of earth, rotten wood, or other surrounding substances, which they have gnawed and cemented together with a glutinous matter. Their food consists of the dung of various animals, mould and the roots of vegetables. Some of them live in decayed vegetable and animal substances, upon which they feed. They sometimes destroy immense quantities of vegetables which are useful to man.

Lamentations of Jeremiah, Book of, *lam'-en-tai'-shuns* (Lat. [illegible]), is the name of one of the canonical books of [illegible]. That this book is the work of the prophet whose name it bears is attested by the most ancient and uniform tradition, and is confirmed by the subject of the book, and by its language and style. This book was evidently written in metre, and consists of a number of plaintiff effusions, composed after the manner of funeral dirges. It is, in our Bible, divided into five chapters, and consists of five distinct elegies. According to Jahn, the book does not relate [illegible] of the poems a different [illegible]. These are:—1. the carrying away of king Jehoiakim, w[illegible] 10,000 of the principal Hebrews (i.); 2. the assault of Jerusalem (ii.); 3. the calamities undergone by the prophet (iii.); 4. the overthrow of Jerusalem, the carrying away of king Zedekiah, and the slaughter of the Hebrews (iv.); 5. the wretched condition of the people, and of Jerusalem after the destruction of the city (v.). Each elegy consists of twenty-two periods, according to the number of letters in the Hebrew alphabet; and in the first four chapters the initial letters of each period follow the order of the alphabet, after the manner of an acrostic. In the third chapter each period contains three verses, all having the same initial letter. The fifth chapter, likewise, has twenty-two verses, but the order of the initial letters is neglected. The style, as the poetic character of the composition required, is somewhat more elevated than that of the prophecies. The tropes correspond with the sorrowful nature of the subject. "Never, perhaps, was there a greater variety of beautiful, tender, and pathetic images, all expressive of the deepest distress and sorrow, more happily chosen and applied, than in the lamentations of this prophet; nor can we too much admire the full and graceful flow of that pathetic eloquence in which the author pours forth the effusions of a patriot heart, and piously weeps over the ruin of his venerable country."—(*Horne.*)

Lamia, *lam'-e-a* (Gr.), in fabulous Hist., a monster said to inhabit the centre of Africa, with the face and upper part of the body like a woman, and the extremities like a serpent. The first lamia, according to classic mythology, was the daughter of Neptune, who, having become insane through the jealousy of Juno, caught and devoured all new-born children she came across. The lamiæ, however, of the ancients, were sometimes represented as a species of monstrous animal, or again as a vampire. This latter character is seized upon, and carried out, by Goethe, in his "Bride of Corinth," where a young man is represented as marrying a lamia, who sucks his life-blood at night. A tale, somewhat similar in construction, occurs also in Philostratus' "Life of Apollonius of Tyana."

Lamiaceæ. (*See* Labiatæ.)

Lamian War, *lăm'-e-ăn*, in the ancient history of Greece, is the name given to that war which sprang up after the death of Alexander, the dependent Greek[illegible] regarding this as a favourable opportunity for regaining their independence. The Athenians took the lead, and were cordially seconded by the [illegible] and a confederacy was formed, com[illegible] most of the other states of Greece. [illegible] force was raised, the command of which was given to Leosthenes, who marched against Antipater, then presiding over Macedonia. Antipater entered Thessaly at the head of 13,000 foot and 600 horse, but was beaten by the superior force of the confederates. With the remains of his force, amounting to about 8,000 or 9,000 men, he took refuge in Lamia, where he resolved to maintain a siege. Leosthenes being unable to take the city by storm, began to besiege it, but his operations were frequently disturbed by the sallies of Antipater, in one of which Leosthenes himself was killed by a stone hurled from an engine. The march of reinforcements to the aid of the besieged, under the command of Leonnatus, compelled the confederates to raise the siege and advance to meet this new force, before a junction should be effected. In the engagement which ensued, Leonnatus was slain, and his army defeated. Craterus next marched to the aid of Antipater, having, besides veterans, 4,000 heavy-armed, 1,000 Persian bowmen and slingers, and 1,500 cavalry. The united Macedonian army then numbered between 40,000 and 50,000 heavy infantry, 3,000 light troops, and 5,000 cavalry; while the Greek forces were little more than half as numerous. At length an engagement took place on the plain of Crannon, in which, though the Greeks were on the point of gaining the victory, they gave up the struggle, though they had lost not more than 500 men. The vanquished army sued for peace. The states found themselves no longer able to maintain the contest, and peace was granted to them on very easy terms, except the Athenians, who were compelled to receive a Macedonian garrison in Munychia, to pay a sum of money for the cost of the war, and deliver up a number of their obnoxious orators, including Demosthenes and Hyperides, who had been the means of inciting their countrymen to war. Demosthenes escaped by taking poison, but Hyperides was condemned to have his tongue cut out, and then to be put to death.

Lamina, *lam'-e-na* (Lat.), meaning a layer, applied to the different plates of minerals, or coats of bone, lying one above another. In Bot., the lamina means the broad and spreading part of the petal of a polypetalous corolla. In Anat., *laminæ* are the two plates or tables of the skull.

Laminæ, *lam'-e-ne*, the name of a tribe or family of longicorn beetles, distinguished, according to Latreille, by their head being vertical; their palpi filiform, with the terminal point more or less oval in shape, and tapering to a point; the maxillæ have the outer lobe slightly narrowed at the end; the thorax nearly equal throughout, exclusive of the lateral spines or tuber-

cules. Some varieties are *apterous*, a modification of structure possessed by no other family of longicorn beetles.

LAMINARIA, *lăm-e-nai'-re-ă* (Lat. *lamina*, a plate or layer), in Bot., a gen. of *Algæ*, or sea-weeds. *L. saccharina* is remarkable for containing upwards of 12 per cent. of the sugary matter called *mannite*. The young parts mixed with those of *L. digitata*, are eaten in Scotland, under the name of *tangle*. In China, *L. saccharina* is called *sea-tape*, and is a common article of food along the coast. *L. potatorum* is another edible species, used as a table vegetable in Australia.

LAMMAS-DAY, *lăm'-măs* (Sax. *hlaf*, loaf; *masse*, holiday or feast), the 1st day of August, which was so called because the Saxons, among whom it was accounted a feast of first-fruits, were accustomed to make offerings of loaves made of new corn on this day; or because tenants were in the habit of bringing a portion of the corn that had been recently cut on the land they occupied, to their landlord, on this day at the latest.

LAMP, *lămp* (Gr. *lampas*, a torch, a lamp), a general term applied to those contrivances which are used for producing light by the combustion of materials that are liquid at ordinary temperatures, such as most of the fixed oils; the solid fats being made into candles. The invention of the lamp is ascribed to the Egyptians. Its use was known in the days of Moses and Job. The application of lamps passed from Egypt into Greece, where they were consecrated to Minerva, the goddess of learning, as indicative of the scholar's nocturnal study. From Greece the use of lamps passed to Rome. Among the Egyptians, Hebrews, Greeks, and Romans, oil lamps were generally used, and they vied with each other in the construction of these instruments. Some of the specimens which have been preserved to the present time display much taste and elegance of design. The interiors of all of them, however, are rough and meagre. The first person who is known to have published a collection of ancient lamps, is Fortunio Liceto, an Italian, whose chief design appears to have been to prove the possibility of constructing lamps which would burn for ever. The sixth hall of the museum of Portici is now entirely filled with lamps and candelabra discovered in the houses of Pompeii and Herculaneum. It would appear that the ancients constructed their earliest lamps of baked earth; but subsequently of various metals—bronze especially. There are a few ancient lamps of iron extant; but they are rare, either because that metal was little used for the purpose, or on account of its rapid decomposition in the ground. There are four specimens in the museum of Portici, and one specimen of a glass lamp, which is entirely solid and in one single piece. A golden lamp in the temple of Minerva is mentioned by Pausanias; and St. Augustine speaks of lamps of silver. There was a strong belief among ancient writers, that perpetual lamps existed. Instances have been cited by various authors where lamps were found burning in ancient sepulchres, which were extinguished as soon as the air was admitted. The most remarkable instance is that of the tomb of Tulliola, daughter of Cicero, discovered at Rome in 1540. The notion, in most of those cases, probably arose from the inflammation of the hydrogen gas which escaped from the tombs when opened. The lamps or candles used by the Jews in their own houses were put into a high stand, raised from the ground. The lamps used by the wise and foolish virgins mentioned in the New Testament were of a different kind. Critics and antiquaries seem to agree that they were a kind of torches, made of iron or potters' earth, wrapped about with linen, and moistened from time to time with oil. It was customary among the Romans to have a lamp either hanging from the ceiling or placed on a stand in the room. These stands were often richly ornamented. (*See* CANDELABRUM.) It was also the custom among the Romans, on occasions of national rejoicing, to have public illuminations; on which occasions lamps were suspended at the windows. The practice of placing lamps in the sepulchres of the dead was probably meant to be allegorical of the cessation of earthly existence. Some of the sepulchral lamps are sculptured with the figure of a butterfly, in reference to the escape of the soul. The early Christians adopted this usage in their monuments; and lamps have been found in the tombs of many saints and martyrs. In treating of the construction of modern lamps, it is necessary to take into consideration the nature of flame. By referring to the article on FLAME, it will be seen that, in order to insure a constant and steady flame, it is necessary that the supply of combustible matter be steady and uniform. It must, therefore, be either in a liquid or gaseous state, so that it may approach the flame in an uninterrupted current. The combustible substance may either be made to approach the flame by capillary attraction through wicks, or by mechanical pressure. A good lamp must have the following properties. It must be supplied with carbonaceous matter and with oxygen; it must convert the former into a gaseous state; and it must bring the gas so produced into contact with oxygen at such a temperature that the carbon will combine with oxygen in the highest degree without producing smoke. The kind of oil used for burning in lamps varies, in different parts of the world, according to the sources of supply. In Great Britain whale-oil is used; but seal-oil, fish-oil, and oils obtained from seeds by pressure, are also largely employed. The oils of rape-seed and poppy-seed are used in Paris, and in the south of France and Italy an inferior kind of olive-oil. In other parts of Italy, lamp-oils are obtained from expressed grape-stones and from walnuts. Oil of sesamum-seed is burnt on the eastern and southern coasts of the Mediterranean; while in tropical countries, cocoa-nut oil is generally used, although it is solid in this country. On account of the deficient supply of tallow during the war with Russia, a number of new oils have been introduced of late into the commerce of this country. They are all used for burning in lamps. The simplest way in which a lamp can be formed is that practised in making night-lights to burn in sick chambers. A small quantity of water is poured into a glass tumbler, or other vessel, and above that a quantity of oil; a piece of cork is then pierced so as to admit a few threads of cotton to pass through it, and the cork being placed upon the oil, will float, the cotton threads will draw up the oil by capillary attraction, and a feeble, but clear, light will be given. The antique lamps spoken of before, many of which possess great artistic beauty of form, cannot claim a higher construction than those of many rude nations. In general, they consist of a vessel, open or closed, with an unspun round wick, which is held by a nozzle at the beak. As combustion can only take place on the outside of the flame, more carbon is likely to be liberated from the oil than the oxygen in contact with the flame can consume. Hence all lamps of this sort give a dim light, easily go out, and possess a smoky flame. The old kitchen-lamp had the beak removed to a considerable distance from the reservoir, so as to lessen the shadow cast by the flame, and increase the illuminating power. Till 1789, however, all lamps continued to be dim, smoky, ill-made articles, soiling everything they came near, and filling the air with anything but an agreeable odour. The invention and introduction of the argand lamp at that time, by Ami Argand, made a revolution in illumination. (*See* ARGAND LAMP.) Among the inventions which appear to indicate important progress in the history of lamp-illumination, may be enumerated the following: —The *Worms lamp*. This lamp is used and well known in the countries bordering on the Rhine. It is characterized by the shape of the wick. The fibres of the wick, instead of being collected into a round bundle, are placed in small bundles side by side, forming together a flat ribbon. The effect produced by this arrangement is that the edges of the flame are at no point so distant that a nucleus can form in the centre, which, from want of air, will burn incompletely and smoke. Another advantage possessed by this and other lamps to be described, is the movability of the wick. This is effected by means of screws. The wick is raised or lowered, according as the screws are turned, and a larger or smaller quantity of air is employed in the combustion. When the wick is high, a large quantity of oil is decomposed, and when low, a small quantity.—The *Study-lamp*. In the common study-lamp, the oil-vessel is more flat, and, instead of being situated below, is behind and at the side of the flame, so that its shadow falls much beyond the immediate

vicinity of the flame, and in no way interferes with the person in front of the lamp. The greater part, too, of the light passing upwards, is collected by a conical shade and reflected downwards.—The *Astral lamp* was constructed by Bordier-Marcet, with the idea of making the sinking of the level of the oil as imperceptible as possible, and, at the same time, the diminution of the flame by means of a very flat oil-vessel, in which, therefore, a larger quantity of oil only occupies a very insignificant height. The principle of the astral lamp was applied to the argand.—In the *Sinumbra-lamp* (*sine umbra*, without shadow), the shadow is greatly reduced by making the circular oil-vessel in such a way that its three surfaces meet in the form of a flat wedge, the sharp edge being directed towards the flame. The position of the flame in relation to the oil-vessel is such, that two tangents drawn from the base to the apex of the flame to the latter, meet a few inches behind it. Beyond this point the lamp can cast no shadow; but even in this small space, it is almost entirely destroyed by a ground-glass shade, which, resting upon the oil-vessel, surrounds the chimney and scatters the light in all directions around. In all these lamps one common evil is to be noticed, namely, that of having the oil-vessel at all events within a few lines of the level of the burner, in a position which, consequently, throws the most objectionable shadow. A large number of contrivances have been invented in order to remove the cistern, either to a considerable distance above the flame—when its shadow would fall on the ceiling—or to a position much below the flame, when it would fall at the foot of the lamp. In the former of these cases, from the peculiar arrangement of the oil-cistern, the height of the oil in the burner cannot be quite constant, but will alternately sink and immediately rise again to its former height; whilst in these lamps described previously, the suction of the wick is always rendered more difficult by the sinking of the oil. When the oil cistern is transposed to the foot of the lamp, all shadow is avoided; but the advantage of the free flow of oil is lost; in all lamps of this sort, therefore, the oil must be raised. They are, therefore, interesting on account of their ingenious, but at the same time complicated, apparatus, which partly depends upon hydrodynamic, partly upon hydrostatic laws, and is partly also a mere mechanical arrangement.—In *Girard's lamp*, the oil is raised by the compression of air somewhat after the manner of water in a fire-engine, or as in Hero's fountain, where the pressure exerted in one vessel is transferred to another distant vessel by means of the compressed air.—The *Hydrostatic lamp*. The principle on which this lamp is constructed is as follows: when two different fluids are brought into tubes connected at the bottom, they will balance each other at different heights in the respective tubes, according to their densities.—In *Keir's* lamp the oil is raised and supported by a column of salt and water, sufficiently dense to support a column of oil [illegible] height. Instead of the salt and water, other heavy liquids, such as syrup, honey, mercury, or a solution of sulphate of zinc, may be used. The zinc solution is 1·57 times denser than oil; hence a column 10 inches high will support a column of oil 15·7 inches in height. —In *Carcel's mechanical lamp* was first carried out the idea of pumping up the oil from the foot of the lamp to the wick by simple machinery, like that of clocks, and in such proportions as to exceed the quantity consumed during the whole period of burning. Carcel brought out his invention about 1800, and carried it to such perfection, that only unimportant points connected with the works and the pump were left for the improvements of his successors, Gagneau, Nicod, Careau, and others. The complex arrangement of the machinery in Carcel's lamp, and other similar instruments, soon caused them to fall into disuse. All the difficulties which encompassed these arrangements seem, however, to have been surmounted in Meyer's elliptic, and in the French moderator lamp. In the *elliptic lamp*, a spiral spring acting on a piston is the motive power, and the constant flow of oil to the wick is regulated in an ingenious manner by means of a tube of narrow bore. A lamp of this kind will yield a good light for eight or ten hours, and will allow of the combustion of crude vegetable oils. The *moderator* lamp, which has become very popular of late years, is similar in principle, but of somewhat different construction. The whole body of the lamp forms a reservoir for the oil, and at the same time the barrel of the pump, in which the piston is worked by a spiral spring firmly attached to it, and to the upper part of the barrel. When the piston presses on the surface of the oil, it forces the fluid up a tube to the burner. The lamp derives its name from a small wire, or moderator, which is placed in the ascending tube, in order to regulate the supply of oil to the wick, and keep the quantity invariable. Volatile oils, such as camphine, are applicable for illuminating purposes in lamps, when they can be obtained at a sufficiently low price; but they require special management and a well-regulated and abundant supply of air to consume completely the large amount of carbon which they contain. When employed instead of oil in ordinary lamps, they evolve a great quantity of smoke, and much of the oil escapes combustion. In many parts of England and the continent, *vapour lamps* are employed. In these lamps, which consume either spirits of wine, mixed with volatile oils rich in carbon, or coal-tar naphtha, the liquid is generally converted into vapour before it reaches the burner, and they are therefore distinguished as *vapour*, or *self-generating gas* lamps. Amongst these may be mentioned Lüdersdorff's lamp, for burning pure oil of turpentine; Mansfield's lamp, for burning mixtures of pyroxylic spirit, or acetone, with various hydro-carbons; Holliday's lamp, for consuming rectified coal-tar naphtha mixed with air; and Beale and D'Hanen's lamps, for the same purpose. Within the last few years, large numbers of inexpensive lamps have been manufactured for the purpose of consuming the paraffin procured from the distillation of the petroleum obtained in the recently-discovered oil-wells of America and elsewhere. The necessity for artificial light in mining operations below the surface, where explosive gases often impregnate the air, at an early period turned the attention of scientific men to the construction of lamps which could be safely used in an explosive atmosphere. In 1815, the discovery of the safety-lamp made independently, by Sir Humphrey Davy and George Stephenson. Although many modifications of form have been made since that time, the modern safety-lamp is still similar in principle to the "Davy" and "Geordy" lamps. (*See* SAFETY-LAMP.)

LAMP-BLACK, a very fine description of infinitely divided charcoal, much used as a pigment in the arts. It is largely manufactured by heating in an iron vessel vegetable matters rich in carbon, such as resin and tar,—the vapours of which are burnt in a current of air insufficient for complete combustion. The hydrogen consequently burns away, leaving the carbon behind in a finely-divided condition on the walls of the chamber, which are hung with coarse cloths. The lamp-black thus obtained generally contains certain quantities of unburnt resinous or fatty matter. Where very fine lamp-black is required in small quantities, it is best made by holding a cold plate over a gas flame until a sufficient deposit is obtained. This is ground up with gum, water, or oil, and forms an excellent pigment for the amateur artist. Lamp-black is one of the ingredients of which printers' ink is made.

LAMPETIANS, *lăm-pe'-she-ăns*, a religious sect of the 17th century, the followers of one Lampetius, a Syrian monk. He held that man, being born free, ought to do nothing by necessity; and hence, that it was unlawful to make vows; to which he added various Arian and other heresies.

LAMPOON, *lăm-poon'* (Fr. *lampons*, a drunken song), is a personal satire, a censure, written not to reform but to vex.

LAMPREY, *lămp'-re* (Dan. *lampret*), (*Petromyzon marinus*), belongs to the *Petromyzidæ*, a family of chondropterygious fishes. The lamprey is distinguished by a cylindrical form, compressed towards the tail, and without any scales. It has seven branchial openings on each side, and another small opening connected with them on the upper surface of the head, situated nearly between the eyes; its maxillary ring, or mouth, is supplied with strong teeth, and in the inner disc there are smaller, rasp-like tubercles; its tongue is so formed that, by a movement of the mouth, it acts like a piston,

and enables the lamprey to attach itself to any foreign body by means of suction. It is usually about two feet in length and of a yellowish colour, mottled with brown irregular streaks. The two dorsal fins are distinctly separated, the second one joining with the tail-fin, as well as with a small strip which represents the anal fin. Mr. Yarrell says, with reference to this fish, that "the lampreys, like the sharks and rays, have no swimming-bladder, and being, also, without pectoral fins, are usually seen near the bottom. To save themselves from the constant muscular exertion which is necessary to prevent them from being carried along with the current of the water, they attach themselves

by the mouth to stones or rocks, and were in consequence called petromyzon, or stone-sucker; while the circular form of the mouth induced the name cyclostomes, or round-mouth fishes, which was bestowed upon them by M. Duméril." The lamprey generally quits the sea in the spring for the purpose of spawning, and then returns back to its element after an absence of a few months. It is a fish in high repute as an article of food, and it is, consequently, much sought after for the table. Those from the river Severn are held in the highest esteem, while those from Worcester especially command the market. It is an historical fact that our king Henry I. died from the effects of a surfeit of lampreys.

Lampyridæ, *lăm-pi'-re-de* (*Lampyris*, Linn.), a family of coleopterous insects, of the section *Malacodermi*. The *Lampyridæ* have five joints to all the tarsi; flexible elytra, with the body usually elongated and somewhat depressed. The head is more or less concealed by the thorax, the mandibles generally small and terminated in a sharp point; the penultimate joint of the tarsi is always bi-lobed, the claws simple, and the antennæ closely approximated at the base. The family of the *Lampyridæ* contains several genera, the most important of which are,—1. *Lycus*, the distinguishing characters of which are, that the fore part of the head is prolonged into a snout, the antennæ serrated, and the elytra usually dilated in the middle or near the posterior part. A species of this genus is found in England,—the *Lycus minutus*; in length it is about a quarter of an inch, and of a black colour, except the antennæ, which are of a brilliant red.—2. *Omalisus*. This genus has the joints of the tarsi elongated and nearly cylindrical, with the penultimate joint heart-shaped; the head not sensibly prolonged in front; the antennæ simple; and the elytra tolerably firm.—3. *Omalisus suturalis*, a black variety, closely resembling the insect last described: it is found in France.—4. *Lampyris*, the glow-worm. (*See* Glow worm.)

Lanarkite, *lăn'-ark-ite*, in Min., a sulpho-carbonate of lead, found in small quantities at Leadhills, in Scotland.

Lancaster Gun and Rifle, *lănk'-ăs-ter*, two weapons which take their name from Mr. Lancaster, a gentleman who introduced the system of elliptic rifling, which he applied to cannon as well as to small-arms. The transverse section of any part of the barrel would show the bore to be elliptical in shape; the eccentricity, however, is so slight that it can scarcely be discovered without the application of a gauge. Although the invention may be original as far as Mr. Lancaster is concerned, the method appears to have been practised in England many years ago, as the system is accurately described in an old [illegible]

The oval form of bore tends to reduce the windage without increasing the friction or resistance of the air to the bullet when it is passing through it. The twist of the grooving, if it may be called so, is one turn in 32 inches. The diameter of the bore is ·498 inch, an eccentricity of ·01 inch in half an inch being sufficient to cause the bullet to rotate on its axis during the entire period of its flight. The bullet used is conical, elliptic in form, and made of the softest lead that can be procured. It should fit the barrel accurately, having a windage of 4 or 5-1,000ths of an inch. From the peculiar formation of the bore, no other kind of bullet can be used in the Lancaster rifle except those that are made expressly for the purpose. The Lancaster guns are rifled on the same principle. Several experiments were made with them at Shoeburyness, and they were used at the siege of Sebastopol; they did not, however, prove as serviceable and effective as the authorities of the Board of Ordnance expected. This was owing to the imperfect manner in which the parts that formed the shells were joined together, the flame produced by the ignition of the charge often penetrating into the interior of the shell and causing it to burst as soon as it had left the mouth of the gun. In addition to this, the elliptic shells were expensive and difficult to make; and from the shape of the bore, and the unyielding nature of the iron of which they were constructed, there was often a difficulty in ramming them home. In addition to this, if a shell stuck fast in its passage through the bore and did not break when the charge was fired, the gun would burst and become useless. *Ref.*—Busk's *Rifle, and how to use it*; Howard's *Treatise on Naval Gunnery*.

Lance. (*See* Spear.)

Lanceolate, *lăn'-se-o-lait* (Lat. *lancea*, a lance), a term used in Bot. to signify a leaf, or other part of a plant which is of a narrow oblong form, gradually tapering towards each extremity. In a similar sense, the same term is used in conchology and entomology.

Lancers, *lăn'-serz*, regiments of light cavalry, common in most European armies, and so called because of their being armed with lances. These weapons are fitted with a shaft of ash or beechwood, between eight and sixteen feet in length, and a steel point about nine inches long, adorned with a small flag, the waving of which is said to frighten the enemy's horses. At the present time, there are five regiments of lancers in the British army.

Lancet, *lăn'-set* (Fr. *lancette*), a sharp-pointed two-edged surgical instrument, used in venesection, and in opening tumours, abscesses, &c.

Lancewood. (*See* Duguetia.)

Land, *lănd* (Sax.), in its general sense, a term applied to soil, or the solid matter of which the earth is composed. In the more restricted and legal acceptation of the word, it signifies every species of ground or earth; as meadows, pastures, woods, moors, waters, marshes, furze, and heath. It also includes dwelling-houses, &c.; for, with the conveyance of land, the structures upon it pass also. Land is considered to extend indefinitely upwards, and downwards to the centre of the globe. The relations of landed property are amongst the most complicated and most important in civil society. They are at the basis of nearly all the relations and institutions of the state; and the strength and vigour of the government depend on their right direction. In them it is possible to trace the progress of a country's civilization;—from hunting and fishing to raising of cattle; from thence to agriculture, conducted by slaves and bondmen, or by freemen with or without a right in the soil. In nearly all modern constitutions, landed property has been taken as the foundation of the more important institutions, and a power has been given to the owners of property over the other members of society. In many modern states it is so provided by the constitution, that the representative body is composed entirely of landed proprietors; it is, however, a very grave question whether this principle is just or not; consequently, in many representative governments, arrangements are made for producing a variety in the condition and rank of the representatives.

Landammann, *lănd'-ăm-măn* (originally *Landamtmann*), in Switzerland, is the title of the highest magistrate in the country, as distinguished from *Stadtamtmann*, the chief magistrate in the city. The highest

magistrate in many of the cantons, as Uri, Schweitz, Underwalden, Glarus, &c., is termed landammann. Most of the cantons have two or more, who command alternately; some only one. The president of the diet of all Switzerland is also called landammann.

LANDAU, *län-daw'*, a carriage of peculiar construction, and so called on account of its having been first made at Landau, in Germany. It is so constructed that the upper part can be thrown open occasionally in fine weather. This is effected by means of jointed metal levers, called *irons*, on the upper quarters. When the carriage is required to be open, the two quarters separate in a joint in the top, and each folds back. These carriages, which are hung and fitted up like coaches, are very convenient, as they serve the purpose of a close and an open carriage, without the expense of keeping two. The landau is a carriage, on the whole, well suited to the uncertain climate of this country, and if built light, without a perch, and with elliptic springs only, is found to be extremely useful.

LANDGRAVE, *länd'-graw* (Ger. *graf* or *grave*, count or judge), a title which was formerly common among the rulers of petty German principalities and kingdoms, but which is now borne only by the ruler of Hesse-Homburg, and a few German noblemen of high rank; among whom may be named the Landgrave Wilhelm of Hesse-Cassel, the grandfather, on her mother's side, of the Princess of Wales. The graves, in early times, were men of integrity and experience, who were chosen by the people of different districts to administer justice among them. The title was afterwards given to persons who were appointed by the sovereign, and were intrusted with the civil administration of a province, having judges under them, who were set over the different districts of which the province was composed. In course of time there were three classes of graves, distinguished as palgraves, margraves, and landgraves, of whom the first acted as judges in the king's court, and settled all cases which it was not considered necessary to bring before the king in person; while the margraves guarded the frontiers of the land, and the landgraves, as it has been said, administered the government of extensive provinces. Subsequently, many of the landgraves asserted their independence, and became the sovereigns of the countries over which they had ruled as viceroys, and among these were the landgraves of Thuringia and Hesse. In the 16th century, Hesse was subdivided into the landgravates of Hesse-Cassel, Hesse-Darmstadt, and Hesse-Homburg; but, in 1803, the landgrave of Hesse-Cassel took the title of elector, and, three years later, the landgrave of Hesse-Darmstadt took the title of grand-duke; and by these they are still known.

LANDING-STAGE, *länd'-ing*, a platform raised on the side of a river or canal for the purpose of landing passengers and goods from vessels that are brought alongside, and receiving the same on board. A landing-stage may be fixed like a wharf, and provided with cranes and appliances for raising heavy bales of merchandise, coals, corn, &c., out of the holds of vessels, or they may be constructed so as to rise and fall with the tide, like the stages and piers erected at various points along the river Thames, between Battersea Bridge and Gravesend, to allow passengers to enter and quit the steamboats that ply on the river. Landing-stages intended chiefly for passengers are provided with offices for the issue of tickets, and means for insuring the receipt of the same from passengers who have arrived at the stage by steamer; while stages for the reception of goods are provided with machinery for weighing the same, and facilitating the loading and discharge of cargoes. Piers that are built on piles, and project a long way into the sea down a gently-shelving beach, afford examples of another kind of landing-stage for landing passengers and goods, and taking them on board at seaports, where the nature of the coast prevents vessels from coming alongside a quay at all times.

LANDLORD AND TENANT, *länd'-lord*, one of the common relationships of social life, out of which arise many rights, duties, liabilities, and remedies. It lies between the landlord, of whom lands or tenements are holden, and the tenant, who, on certain conditions, has temporary possession and use of that which is in reality the property of the landlord. Tenancies may be held for fixed periods, or may exist at will and by sufferance. A tenant at will cannot be turned out of possession lawfully, nor can the landlord succeed in an action of ejectment against him, until after a demand to quit has been made upon him by his landlord; but a tenant by sufferance may be turned out by an action of ejectment without a demand. Generally, the tenant is not entitled to set off against his rent debts due to him from the landlord: he is also bound to repair the premises. In agricultural tenancies, the mode in which the farm is to be treated is usually stated in the lease. A tenant in occupation of premises is liable for all taxes and rates of every description due in respect of the premises; the collector, therefore, may proceed against the tenant in occupation to recover them: an agreement is generally arranged beforehand between landlord and tenant that the latter shall pay all rates and taxes except the land-tax. When a fixed rent has been agreed upon, becomes due, and is neither paid nor offered, the landlord, under certain conditions, has a right to seize growing crops, any kind of stock, goods, or chattels, upon the premises, whether such things are the actual property of the tenant or not; and if the rent remains unpaid, he may sell them. The exceptions are,—things in actual use, as clothes then being worn, or a horse on which a person is actually riding; things sent by a tradesman for the purpose of being worked up; goods sent by a principal to his factor for sale; goods and cattle belonging to the guests at an inn; goods that are already in the custody of the law, &c., are also exempt from being seized. (*See* DISTRESS.) The deed, or note in writing between landlord and tenant must proceed upon mutual agreement, and must be signed and duly stamped. A yearly tenancy, when no period of notice is agreed on, must be determined by a notice to quit at the expiration of the current year, given six months previously. In the case of lodgings, the time, when less than a year, for which they are taken, will be the time [illegible]ary; thus, lodgings taken by the month or week need a month's or a week's notice. A notice to quit may, however, be waived by an acceptance of rent, or by a distress for rent due, after the expiration of the notice.

LANDMARK, *länd'-mark*, an object to ascertain the boundaries of an estate or property. The correct division of lands was an object of great importance in ancient times. Various means were consequently adopted to render the boundaries of property distinct and permanent. The most general landmarks were stones and hillocks. Amongst the ancient Hebrews, the importance attached to these objects may be judged of from the objurgation of Moses: "Cursed be he that removeth his neighbour's landmark." In naval language, a landmark is any conspicuous object on shore which serves as a guide in entering a harbour, in making a fishing-station, or in avoiding a danger.

LANDRAIL. (*See* CORNCRAKE.)

LANDSCAPE, *länd'-skaip* (Du. *landschap*), in general language, a portion of country which the eye can comprehend in a single view, including mountains, rivers, lakes, and whatever else the land may contain. The word landscape is also very commonly used to denote a picture representing the form of a district of country as far as the eye can reach. The art of painting landscapes may be said not to have originated till the 14th or 15th century. From that time, however, it claimed the attention and admiration of artists, who, by imparting ideal beauty to the scenes which they depicted, elevated the art to the high position in which it now stands. (*See* PAINTING.)

LANDSCAPE GARDENING. (*See* GARDENING.)

LANDSCAPE PAINTING. (*See* PAINTING.)

LANDS, FINE OF. (*See* FINE OF LANDS.)

LANDSLIP, *länd'-slip*, a portion of land which has been separated from the main body, or which has slid down, usually from the side of a mountain or hill, in consequence of disturbance by an earthquake, or from being undermined by long-continued rains, or from some other cause. Landslips of considerable extent sometimes occur, and are occasionally attended with great injury. In Switzerland and other mountainous countries they are not unfrequent.

LAND-TAX, *länd'-täks*, a tax laid upon land and houses, which has superseded all the previous methods

of rating either property or persons in respect of their property, whether by tenths or fifteenths, subsidies on land, hydages, scutages, or talliages. The land-tax is levied neither on landlord nor tenant, although generally a charge upon a landlord, but on the beneficial proprietor, as distinguished from the mere tenant at rack-rent. If a tenant have a beneficial interest to any extent, he becomes liable to the tax *pro tanto*, and can only charge the residue to his landlord. Houses and buildings appropriated to public purposes are not liable to land-tax.

Landwehr, *länd'-vair* (Ger., land-guard), a term applied in Prussia and Austria to the militia of the country. (*See* also article **Militia**.)

Langrel, or **Langrage Shot** (*läng'-grel*), a peculiar species of missile, formed of bolts, nails, and other pieces of iron, tied together, and shaped like a cylinder, so as to suit the bore of the gun from which it is to be discharged. It used formerly to be employed at sea for the purpose of destroying the spars and rigging of hostile vessels, but in the present day its use has nearly, if not quite, exploded.

Langsat. (*See* **Lansium**.)

Langsdorffia. (*See* **Balanophoraceæ**.)

Language of Flowers, *läng'-gwaj* (Fr. *langage*), means an emblematical mode of expressing and interchanging ideas by means of flowers. The origin of this practice was doubtless suggested by the natural characteristics of certain flowers. "Lovely as the rose," "Fair as the lily," and "Modest as the violet," are phrases that seem to come naturally into use. Acting upon this principle, several elegant little works have been drawn out, in which nearly every known flower is tabularly arranged, with the object which it is supposed to symbolize placed beside it. Amongst the best known are the carnation, signifying fascination; the dahlia, instability; the rose, love; the geranium, gentility; the forget-me-not, remembrance; the fuchsia, elegance; and the ivy, friendship.

Language, Science of. (*See* **Philology**.)

Languages, Dead. (*See* **Dead Languages**.)

Lansium, *län'-shum*, in Bot., a gen. of plants of the nat. ord. *Meliaceæ*, inhabiting the East-Indian Archipelago. They yield fruits which are much esteemed, and known under the names of the *langsat* or *lanseh*, and the *ayer-ayer*.

Lantanium, or **Lanthanium**, *län-tai'-ne-um* (Gr. *lanthanein*, to conceal),—symbol La, equiv. 47. An extremely rare metal, found in small quantities in the minerals *cerite*, *yttrocerite*, and one or two more, in company with cerium and didymium. It forms a grey infusible non-volatile powder, that becomes lustrous when burnished. It forms only one oxide, LaO, which is a white powder, soluble in acids, and in the salts of ammonia, from which it expels the alkali. Its salts have a sweet astringent taste, and are unimportant.

Lantern, *län'-tern* (Lat. *laterna*, Fr. *lanterne*), a common contrivance used for carrying a lamp or candle in, consisting of a case or vessel made of tin, with sashes of some transparent substance, such as horn or glass. Lanterns are first spoken of by Theopompus, a Greek comic poet, and Empedocles of Agrigentum. Lanterns were used by the ancients in augury. They were also carried before troops on the march by night, being then borne on the top of pikes, and so constructed as throw lights only behind them. Dark lanterns are provided only with a single opening, which can be closed up when the light is required to be hidden, or opened when there is occasion for its assistance to discover some object. In architecture, the lantern signifies a small dome raised over the roof of a building to give light and serve as a sort of crowning to the edifice.

Lanterns, F[illegible] of, a celebrated feast held in China on the [illegible] day of the first month of the year. It derives [illegible] from the vast number of lanterns which are [illegible] out of the houses and in the streets, the numb[illegible] which has been stated even to have exceeded [illegible],000,000. The lanterns used are often of great valu[illegible] some being estimated at 2,000 crowns. They are richly ornamented with gilding, painting, two or three together would make an elegant house. In this way the Chinese may be said to live, to receive visits, dance, and act plays in a lantern. When lighted up with torches, these lanterns have a beautiful effect at a distance. Besides the large lanterns, there are also a vast number of smaller ones, which usually consist of six faces or lights, each about four feet high and one and a half broad, framed in wood, finely gilt and adorned. Over these they stretch a fine transparent silk, painted with flowers, trees, and other objects; the colours are very vivid, and, when the lanterns are lighted up, the effect is lively and picturesque.

Lantern-Fly. (*See* **Fulgora**.)

Lantern, Magic. (*See* **Magic Lantern**.)

Lapidary-work, *läp'-e-dä-re* (Lat. *lapis*, a stone).—The employment of the lapidary consists in cutting and polishing gems and precious stones, and any description of hard mineral substance that may be used for ornamental purposes. Lapidary-work is entirely performed by the friction of small metal or wooden wheels, which revolve with great rapidity, being frequently driven by means of a small steam-engine. For cutting gems and stones, the wheels are made of iron, and have a sharp edge, to which diamond or emery-powder moistened with water is applied during the operation; but for polishing the same, wheels made of softer metal, or wood, are used, the edges of the wooden wheels being sometimes coated with buff leather; but when the wheels are without a coating of leather, the stone is frequently held against the side instead of the edge. Gems and precious stones differ greatly from each other in hardness, and require a different mode of treatment accordingly, although the means used for cutting and polishing are the same in all cases. The softest substances that are cut by the lapidary are alabaster, mother-of-pearl, coral, malachite, and glass; the emerald, agate, garnet, amethyst, opal, topaz, carbuncle, and many kinds of ornamental stone, are considerably harder than the substances that have just been mentioned, but not so hard or difficult to cut as the diamond, sapphire, and ruby. Among the most important examples of lapidary-work may be cited the re-cutting of the large Indian diamond known as the *Kohinoor*, or Mountain of Light. (*See* **Kohinoor**.)

Lapis Lazuli, *lai'-pis läz'-u-le* (Lat., azure-stone), a well-known mineral of an ultramarine or azure-blue colour, formerly much used for the production of the pigment known as ultramarine. It varies considerably in composition, according to the locality in which it is found. It may be described chemically as a silicate of alumina and lime, coloured with variable amounts of iron and sulphur. Since the introduction of artificial ultramarine, it is principally employed for ornamental purposes. (*See* **Ultramarine**.)

Lapse, *läps* (Lat. *lapsus*, a slip), in Eccl. Law, is a slip or omission of a patron to present a clergyman to a benefice in his gift within six months after its vacancy, in which case the benefice lapses to the bishop; and if he does not collate within six months, it lapses to the archbishop; and if he neglect to collate within six months, it lapses to the crown. A lapsed legacy, is where the legatee dies before the testator, or where a legacy is given upon a future contingency, and the legatee dies before the contingency happens.

Lapsed, *läpsd*, in Eccl. Hist., is a term applied to such as in the time of persecution denied the faith of Christ. Much controversy arose in the Church in early times as to how such persons should be dealt with on their seeking to be re-admitted.

Lapwing, or **Peewit**, *läp'-wing*, one of the best-known of the British birds, belongs to the snipe and plover tribe. The generic characters of this bird, whose scientific name is *Vanellus cristatus*, are,—straight slightly-compressed bill, shorter than the head; points of both mandibles hard and horny; legs slender, with lower part of tibiæ naked; four-toed feet—three before, one behind; large wings, tuberculated or spurred in front of the carpal joint; first three quill-feathers shorter than the fifth. The names which this bird bears have been suggested, the first by the slow flapping of its wings during flight, and the second by its often-repeated note, with which the sound peewit is closely similar. An inhabitant of heaths, commons,

and the marshy grounds near rivers or lakes, these birds resort in numerous flocks to certain districts in Norfolk, Lincolnshire, Cambridgeshire, and Essex, where the trade of collecting them for the table continues for about two months.

LARBOARD, *lar'-bord* (Ang.-Sax.), a term formerly applied to that side of a ship which is on the left hand of a person looking forward from the stern. At present, the term *port* is used instead.

LARCENY, *lar'-se-ne* (Nor., from Lat. *latrocinium*), is another term for theft. It is divided into two kinds,—simple larceny, or plain theft, when it is unaccompanied with any aggravating circumstances; and mixed, or compound larceny, when accompanied by circumstances which are considered as aggravating the offence. Formerly, larceny was distinguished as grand and petty larceny; the former, when the value of the goods stolen was above twelve pence, the latter when not more than that value; but by 7 & 8 Geo. IV. c. 28, that distinction was abolished. Simple larceny, then, is defined to be "the felonious taking and carrying away of the personal goods of another." In larceny there must be,—1. a taking against the will of the owner; for wherever the owner is induced willingly to part with his goods, there is no larceny; as where goods are delivered upon trust. If A. lends a horse to B., and he rides away with him, this is not larceny. Larceny is not committed when possession is obtained in the first instance without fraudulent intention. Where a finder of goods or money converts the same to his own use, and at the time of conversion knows, or has the means of knowing, the real owner, he is guilty of larceny; but if he find it with the intent to restore it, but afterwards appropriates it to his own use, he does not commit larceny. A servant intrusted with his master's goods, as a butler with plate, a shepherd with sheep, and embezzling them, is guilty of larceny at common law; but if the goods have never been in the possession of the master, as money or goods received by a servant from a third party, and embezzled, it is not larceny. If a guest robs his inn or tavern of a piece of plate, or if a lodger run away with goods from his lodgings, it is larceny; for he had not the possession delivered unto him, but the use. Under some circumstances, a man may be guilty of larceny in taking his own goods; as if he steals them from a pawnbroker. The distinction as to what constitutes larceny will thus be seen to be often very nice; and hence various statutes have been passed providing for particular cases; as for frauds by bankers, brokers, agents, trustees, &c. —2. There must not only be a taking but a carrying away (*cepit et asportavit*), to constitute larceny. A bare removal from the place in which he found the goods, though he does not quite make off with them, is a sufficient asportation or carrying away. Thus, where a thief, intending to steal plate, takes it out of a chest in which it was, and lays it down upon the floor, but is surprised before he can make off with it, this is larceny.—3. The taking away must be felonious, that is, *animo furandi*, or, as the civil law expresses it, *lucri causâ*. The ordinary discovery of a felonious intent is where the party does it clandestinely, or, being charged with the fact, denies it; but there are numerous other circumstances that may be taken as evidence of a felonious intent so complicated and mingled, that it is impossible for us to enter upon them in this place. — 4. The felonious taking and carrying away must be of the personal goods of another; for if they are things real, or savour of the realty, larceny at common law cannot be committed of them. Lands, tenements, and hereditaments, cannot in their nature be taken and carried away; but even corn, grass, trees, and the like, were regarded as part of the real estate, absolutely fixed and immovable, and therefore unable to be the subject of theft by the common law. Most of these cases are now made felonies by statutes, particularly 7 & 8 Geo. IV. c. 29. Upon the same principle, the stealing of writings relating to a real estate was no felony, but a trespass, because they concerned the land. By the above statute this is made a misdemeanour, punishable with transportation (now penal servitude) for seven years, or fine or imprisonment. Bills, bonds, and notes, being of no intrinsic value, and not importing any property in possession of the person from whom they were taken, were not at the common law held to be such goods whereof larceny might be committed; but by 7 & 8 Geo. IV. c. 29, they are now put, with respect to larcenies, upon the same footing as the money they were meant to secure. No larceny can be committed of things which are not the subject of property; as of beasts that are *feræ naturæ* and unreclaimed, as deer, hares, and conies, in a forest, chase, or warren; fish in an open river or pond; or wild fowls in their natural liberty. But if they are reclaimed or confined, and may serve as food, it is otherwise. Of all valuable domestic animals, as horses and other beasts of draught, and of all animals *domitæ naturæ* which serve for food, as neat or other cattle, swine, poultry, and the like, larceny may be committed. But the stealing of dogs, cats, and ferrets, though tame and valuable, and of monkeys, bears, &c., though reclaimed or confined, does not amount to larceny. By 7 & 8 Geo. IV. c. 29, every person convicted of larceny of any amount is declared liable to be transported for seven years, or imprisoned for not more than two years. But by 12 & 13 Vict. c. 11, the punishment of transportation for persons convicted of simple larceny was taken away; and, according to the provisions now in force, the punishment for this offence is, in ordinary cases, imprisonment with hard labour (with or without solitary confinement) for not more than two years, and (if the offender be a male) whipping, at the discretion of the court; in case of having been before twice convicted of any of the offences punishable upon summary conviction under 7 & 8 Geo. IV. cc. 29, 30, or 10 & 11 Vict. c. 82, penal servitude for not more than seven or less than three years; and in case of a conviction after a previous conviction for felony, penal servitude for not more than ten or less than four years. In certain cases, however, where the larceny relates to a subject for which the policy of the law provides with more anxiety, the punishment is even more severe; for if any person shall steal (to the value of ten shillings) goods or articles of silk, woollen, linen, or cotton, while laid or exposed in any place during any stage or process of manufacture, he shall be liable to penal servitude for not more than fifteen or less than ten years, or imprisonment for a term not exceeding three years, with hard labour and solitary confinement if the court shall see meet. The like punishment is accorded to cattle-stealing. By statute 1 Vict. c. 36, if any officer or servant of the post-office shall steal, secrete, embezzle, or destroy, any post letter containing any chattel or money, or valuable security, or shall steal money or valuable security out of any post letter, he shall be guilty of felony, punishable with transportation for life, or not less than seven years, or imprisonment for four. Larceny by clerks and servants is punishable by penal servitude or by imprisonment (7 & 8 Geo. IV. c. 29). Simple larcenies, where the value of the property does not exceed five shillings, or where the age of the offender is not more than sixteen, may now be tried and determined, with consent of the accused person, by magistrates in petty sessions, the punishment in such cases being limited to six months' imprisonment. Persons confessing charges of simple larceny may also, by 18 & 19 Vict. c. 126, be tried and summarily sentenced by the same tribunal. Compound larceny is such as has all the properties of the former, but is accompanied by circumstances which are considered as aggravating the offence and requiring an increase of punishment; as stealing from one's house or person. The stealing in any dwelling-house any chattel, money, or valuable security, to the value of £5 or more, or counselling the commission thereof; the breaking any dwelling-house, and stealing therein any chattel, money, or valuable security, to any value whatever, are offences punishable with penal servitude for not less than seven or more than fifteen years, or imprisonment for three years. When the breaking the house is by night, then it constitutes another offence,—namely, burglary. Larceny from a church, or, as it is sometimes called, sacrilege, may be punished by penal servitude for life. Larceny from the person is either by privately stealing, or by open and violent assault, usually called robbery. This last is the unlawful and forcible taking from the person of another of goods or money to any value, by violence, or putting him in fear. The taking may not be strictly from

his person,—it may be in his [illegible] only; but if neither from his person nor in [illegible] presence, it is no robbery. The value is immaterial,—a penny as well as a pound may constitute robbery. The taking must be [illegible] force, or a previous putting in fear; being that [illegible] distinguishes robbery from other larcenies. The putting in fear does not necessarily imply any great degree of terror or fright; it is enough that such force or threatening by word or gesture was such as to create an apprehension of danger, or induce him to part with his money without his consent. By 7 & 8 Geo. IV. c. 29, and subsequent statutes, it is provided that whosoever shall rob any person, and at the time of such robbery shall stab, cut, or wound any person, shall suffer death; whoever being armed with any offensive weapon or instrument shall rob, or assault with intent to rob, any person, or shall rob any person, and at the time of such robbery shall beat, strike, or use any other personal violence to any person, shall be [illegible], and may be sentenced to penal servitude for life, or not less than fifteen years, or imprisoned for not more than three years, whoever shall rob any person or steal any property from the person of another, shall be kept in penal servitude for a period not exceeding fifteen years, nor less than ten, or be imprisoned for not more than three; whoever shall assault any person with intent to rob, shall be guilty of felony, and be imprisoned for not more than three years.—*Ref.* Stephen's *Commentaries on the Laws of England.*

LARCH. (*See* ABIES.)

LARCH, USES OF THE, *lartsh* (Lat. *larix*).—The larch is a kind of fir, of elegant and graceful appearance, which is much grown in England for the sake of the timber that is obtained from it. There are many points in which the wood of the larch is superior to any other for certain purposes. For timbers that are exposed to the action of water, and for posts, the ends of which are driven into the ground or into the banks of rivers, the larch is more durable than either oak or elm; and for this reason it is much used by civil engineers in the construction of railways, canals, wooden bridges, &c. It will bear a considerable degree of heat without shrinking, warping, or cracking. It is tolerably free from knots, and the grain is close and capable of receiving a high degree of polish. It is not as easy to saw and plane as deal, chestnut, and oak; and, consequently, it is not used to any great extent in house-joining. It is as good as oak for planking the sides of small vessels; and, on account of the manner in which it will bear the changes of temperature and the variations of the weather, it is particularly useful for railway-sleepers, the shafts of mill-wheels, and other purposes where it is exposed to damp. Pipes for the conveyance of water are made from the larch in France and Switzerland, and larch poles are used in the continental vineyards for the support of the vines. The wood yields an excellent charcoal, and a superior kind of turpentine, known as Venice turpentine, is procured by making incisions in the tree, and collecting the sap that exudes from it in vessels placed to receive it. Squared logs of larch are used for building houses in Switzerland; and in the Rhenish provinces of Prussia, France, and Germany, wine-casks are made from it. The bark is used in tanning leather, but it is not as good as the bark of the oak. The planting of the larch has been much encouraged of late years in Great Britain, nearly fifteen million of trees having been planted on the estates of the duke of Athole in Scotland between the years 1764 and 1826. It will grow on any land, however poor or barren it may be; and land which is utterly worthless for other purposes may thus be made valuable and remunerative.

LARD, *lard* (Fr. *lard*, Lat. *lardum*), the fat of swine after being [illegible] and separated from the flesh. In the pig, [illegible] differs from that of almost every other quadruped [illegible] covers the animal all over, and forms a thick [illegible] between the flesh and the skin, not unlike the b[illegible] whales. Lard is applicable to various purp[illegible] in medicine and in cookery. In the former [illegible] it is specially useful in making ointment. It [illegible] prepared by melting it in a jar placed [illegible] of water, and in this state to boil it and run [illegible] bladders that have been cleaned with great care. [illegible] lard keeps better in small bladders. That portion of the fat which adheres to the parts connected with the intestines is used for greasing carriage-wheels, and differs from common lard.

LARDIZABALACEÆ, *lar-de-zăb-ă-lai'-se-e* (after Lardizabal, a Spanish naturalist), in Bot., the *Lardizabala* fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*. Twining shrubs, with alternate, exstipulate, compound leaves and unisexual flowers. Carpels distinct, superior; seeds parietal, and imbedded on the inner surface; embryo usually minute, with abundant homogeneous albumen. Two genera inhabit the cooler parts of South America, one is tropical, and the remainder are found in the temperate parts of China. The order has furnished our greenhouses with some pretty evergreen climbers.

LARK. (*See* ALAUDA.)

LARUS. (*See* GULL.)

LARVA, *lar'-vă* (Lat., a mask), a term applied to an insect in its first state after leaving the egg, and previous to its assuming the chrysalis or pupa form. Larvæ are generally known by the names of grubs, maggots, and caterpillars. (*See* INSECTA, INSECT-TRANSFORMATION.)

LARYNGITIS, *lăr-in-ji'-tis* (Lat.), in Med., is inflammation of the larynx, more particularly of the mucous membrane that covers the laryngeal cartilages, including the epiglottis. This disease is characterised by a high degree of fever; the pulse is frequent and hard, and the patient manifests a considerable degree of restlessness and anxiety; he likewise complains of sore throat; and among the earliest symptoms that bespeak danger is difficulty of deglutition, for which no adequate cause is visible in the fauces; and to this is presently added difficulty of breathing. The act of inspiration is protracted and wheezing, and the patient points to the *pomum Adami* as the seat of the disease. He speaks either hoarsely, or, what is more common, all power of audible voice in the larynx is lost, and he speaks only by means of his lips and tongue in a whisper. As the disorder advances, the patient's general distress increases. His countenance, from being flushed, becomes pale or livid; his look anxious and ghastly; he struggles for breath, and if he does not obtain timely relief, dies strangled. Its course is generally rapid, terminating fatally before the fifth day, and even, in some cases, within twelve hours. Active remedies, therefore, require to be promptly applied. Blood-letting, both generally and locally, and blistering, are to be immediately resorted to during the periods of the fever; but if the powers are beginning to sink, blood-letting will be of little use. In such cases, however, tracheotomy may be resorted to with advantage, and the operation of breathing carried on by means of an artificial opening till the parts of the larynx recover. (*See* TRACHEOTOMY.)

LARYNX, *lăr'-inks* (Lat.), is the name given to the organ of the voice situated at the upper and fore part of the neck, where it forms a considerable projection. It extends from the base of the tongue to the trachea; is narrow and cylindrical below, but broad above, where it presents the form of a triangular box, being flattened behind and at the sides, whilst in front it is bounded by a prominent vertical ridge. It is composed of cartilages connected together by ligaments, moved by numerous muscles, lined by mucous membrane, and supplied with vessels and nerves. The cartilages of the larynx are nine in number, three single and three in pairs; viz., the thyroid, cricoid, epiglottis, the two arytenoid, the two cornicula laryngis, and the two cuneiform. The thyroid cartilage consists of two plates, of a dense, tough, fibro-cartilaginous substance, irregularly quadrilateral in form, and united at an acute angle in front, forming that prominence which is felt in front of the throat called *pomum Adami*. The lower border is connected with the cricoid cartilage, so called from its resemblance to a signet-ring (Gr. *krikos*, *eidos*, like a ring). It is smaller, but thicker and stronger, than the thyroid cartilage, and forms the lower and back part of the cavity of the larynx. The arytenoid cartilages are each of the form of an irregular triangular pyramid, and are placed upon the upper edge of the broad part of the cricoid cartilage, at the back of the larynx. The base of each cartilage is broad, and presents a concave smooth surface for arti-

culation with the cricoid cartilage. The top of each cartilage is surmounted by a [illegible] cartilaginous nodule,—the corniculum laryngis. The cuneiform cartilages are two small cartilaginous bodies placed, one on each side, in the fold of mucous membrane which extends from the apex of the arytenoid cartilage to the side of the epiglottis. The epiglottis is a thin lamella of fibro-cartilage shaped like a leaf, and placed behind the tongue, in front of the superior opening of the larynx. During respiration, its direction is vertically upwards, its free extremity curving forwards towards the base of the tongue; but when the larynx is drawn up beneath the base of the tongue during deglutition, it is carried downwards and backwards, so as to completely close the opening of the larynx. The upper opening of the larynx is termed the glottis. The mucous membrane of the larynx is continuous with that lining the mouth and pharynx, and is prolonged through the trachea and bronchi into the lungs. The vocal ligaments are two narrow bands of dense fibrous and highly elastic tissue, stretched between the anterior angle of the thyroid and the anterior surfaces of the arytenoid cartilages.

LASCAR, *lăs-kar'*, a term borrowed from the Hindoo, and applied to a native Indian seaman, many of whom are employed in the English mercantile navy.

LAST, *lăst*, a measure, varying in different counties as well as with respect to different districts. The general rule, however, is to accept a last as containing 4,000 lb.

LASTREA, *lăs'-tre-ă*, a gen. of ferns containing several species, belonging to the tribe *Aspidiæ*; such as the *Lastrea filix-mas*, or male fern. This fern has been used in this country and other parts of Europe in medicine; the rhizome, when powdered, is considered an excellent vermifuge, especially in cases of tapeworm. It is also used for tanning.

LATEEN SAILS, *lă-teen'*, in Mar., triangular sails employed in various kinds of vessels. They are extended by long yards called *lateen yards*, slung at one quarter the distance from the lower end, and brought down at the tack, while the other end is elevated at an angle of 45 degrees.

LATENT HEAT. (*See* HEAT.)

LATERAL OPERATION, *lăt'-e-răl* (Lat. *latus*, the side), in Surg., is one of the methods of cutting for the stone.

LATERAN COUNCILS, *lăt'-e-răn*, is a name given to certain councils of the Roman church, from being held in the church of St. John of Lateran, at Rome. The first of these was assembled in 1123, by Pope Calixtus II., who presided in person. It decreed that investiture to [illegible] dignities was the exclusive right of the [illegible] also decreed the celibacy of the clergy. [illegible] was held in 1139, under the presidency of Pope Innocent II. It affirmed the due election of this pope, and condemned the errors of Peter de Bruys and Arnold of Brescia. Lateran III., held in 1179, under Pope Alexander III., condemned the "errors and impieties" of the Waldenses and Albigenses. Lateran IV., in 1215, under Innocent III., had for its objects the recovery of the Holy Land, the reformation of abuses, and the extirpation of heresy. Lateran V., in 1512, was assembled by Pope Julius II., [illegible] by nine cardinals the year [illegible] to [illegible] his [illegible] [illegible] strengthened the power of the Roman [illegible]

LATICLAVE, [illegible] (Lat. *latus*, [illegible]), in [illegible]

[illegible] [illegible] the [illegible] or lath [illegible] work are split out [illegible] of walls or the joists of [illegible] apart, to form a support [illegible] is spread over them. Laths of [illegible] used in roofing, to form [illegible] bers of the roof on which the slates or tiles may be suspended, by means of wooden pegs driven through them. Laths of this description are about an inch in width, and from three to four feet in length. Laths of oak, six feet and more in length, and six or eight inches in breadth, are used for a kind of fence known as "park paling." The manufacture of laths, or lath-rending, as it is technically called, is a trade in itself.

LATHE.—A lathe for turning irregular forms has been invented by Mr. Blanchard. This machine is represented in its most simple form at fig. 1. It is adapted for turning shoe-lasts, and is so constructed, that from one as a pattern an exact fac-simile can be made from a rough block of wood. Both the pattern and the block are fixed upon the same axis, and are made to revolve around their common centre in a swinging lathe by a pulley and belt at one end of the axis, as shown in the figure. On a sliding carriage are attached three posts, through which are fixed pivots, to which are suspended the axles of a cutting and a friction-wheel. The cutting-wheel, which is about one foot in diameter, turns on a horizontal axle, and to its periphery are fixed a number of [illegible] cutters, to act like a gouge when the wheel is [illegible] tion. The friction-wheel, which is of the same [illegible] wheel, is placed opposite the [illegible] against it when in motion. These two [illegible] with each other, and are attached to [illegible] On the axle of the cutting-w[illegible] around which passes a band [illegible] wheel in motion by a large [illegible] it. A crank, or prime [illegible] the drum, which, in its [illegible] to the cutting-wheel [illegible] a small pulley on the [illegible] feeding screw-pulley [illegible] horizontally [illegible] drum-shaft [illegible] the

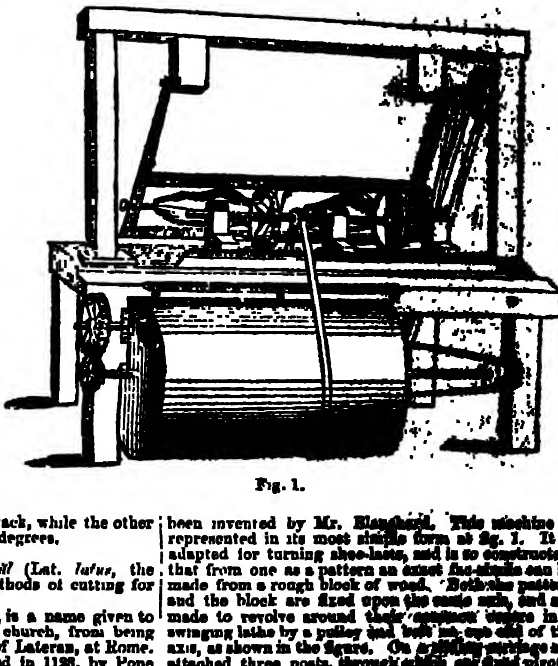


Fig. 1.

pattern and the rough block, in a [illegible] the cutting-wheel. The [illegible] the pattern resting against [illegible] revolution the pattern, being [illegible] in its surface, causes the axis to approach [illegible] from the wheel. Thus it will be seen, as [illegible] surface to the friction-wheel, [illegible], the block presents its surface to [illegible], which, being in rapid motion, cuts [illegible] of the block which is farther from [illegible] than the surface of the pattern, [illegible] a rough block an exact resemblance of the model. Another application of the [illegible] is shown in fig. 2. This machine can turn [illegible] duplicate or fac-simile of any pattern whatever, [illegible] is now brought to such perfection, that an [illegible], and a last are all turned upon it [illegible] and equal perfection. The figure gives a front view of the machine, as seen looking somewhat down upon it. A is the frame; B is a pattern, and if a guide pressing on the pattern directs a wheel, with cutters to operate on the rough material, [illegible] a surface like the pattern so guided, a perfect representation of the pattern will be produced on what was the rough material,—simply by the cutters chipping away all the rough materials outside the axis of direction,—in other words, all the wood on the rough material outside of the pattern. This is the principle on which the machine is constructed;—The cutting-frame slides from one end to the other of the pattern; and the small guide, seen on the frame pressing on the pattern, makes the cutters chip away all the rough material outside of the pattern on G as the cutter-frame moves from end to end of the lathe. The cutter-wheel has three motions—a rotary, a horizontal, and an eccentric one. The pattern and rough material revolve in the lathe. This is effected by three pinions on the right, moved by the pulley seen above K. The speed of the spindles in the lathe is regu-

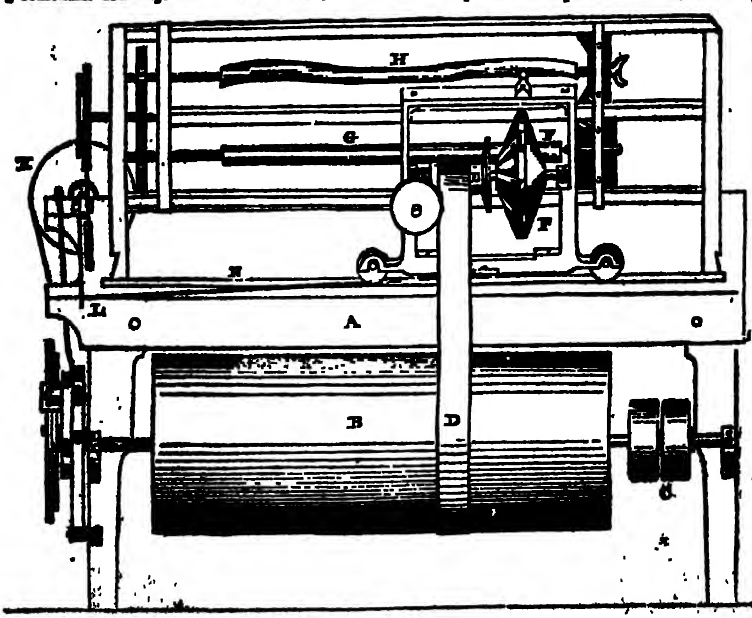


Fig 2.

large drum; C is a driving-pulley; D is a band which, from the drum, passes over the pulley E, and drives its rotary cutter-wheel F F; this cutter-wheel is fixed on an axis in a small sliding-frame, which moves from one end to the other of the lathe by a cord (N), winding upon a spindle lying across the machine, which cannot therefore be seen, but which is driven by the large pulley K, thus giving it a requisite slow motion. H is the pattern axe-helve, and G the rough material to be cut exactly like H. The pattern and rough material are placed in the lathe, represented by the upright frame, and sustained by spindles. On the back part of the machine there is a curious but beautiful [illegible] which is the subject of a patent in itself. [illegible] along after the cutter-wheel, and has two [illegible], on which the pattern and cut-helve r[illegible] pattern and helve roll upon the planes, while [illegible] rocking motion, which accommodates [illegible] all the uneven turning of the patterns, &c., as the [illegible] For turning [illegible] articles, this rest is a [illegible] and positively nece[illegible] mach[illegible] turn a fac-simile of [illegible] at once [illegible] to every mechanic that if a pattern be pl[illegible] lathe, and the material to be turned be placed [illegible] its axis of rotation similar to that of the lated by a very excellent arrangement of a small gang-pulley and straps, seen on the right at the end of the machine. These pulleys are operated by a lever (L), and they are so arranged that a slower motion is communicated to the spindles when the thicker part of the pattern is to be turned, or such a part as an oar-blade. The cutter-frame moves along from one end to the other of the lathe upon a rail, and it is pressed out and in accordance to the shape of the pattern, by the upper guide; and the cutter-wheel being directed in the same manner, thus cuts the pattern on the rough material. The strap D is retained in its proper place by a grooved pulley in the cutter-frame, and the whole kept firm to the work to be turned. A small engine-lathe is shown at figs. 3 and 4. Fig. 3 is a side elevation, fig. 4 an end elevation; A is the bed-piece and head-stool cast in one piece; B, the spindle, which runs in gun-metal boxes; C are cone-pulleys on a live spindle; D are t[illegible] for driving feed-shaft; D', [illegible] driving feed-shaft,—it runs [illegible] a pinion on the inner end to [illegible] E are worms—one right, the ot[illegible] the two worm-wheels so as to feed towards the right or left, as the operator may wish. On the worm-gear

Fig. 3.

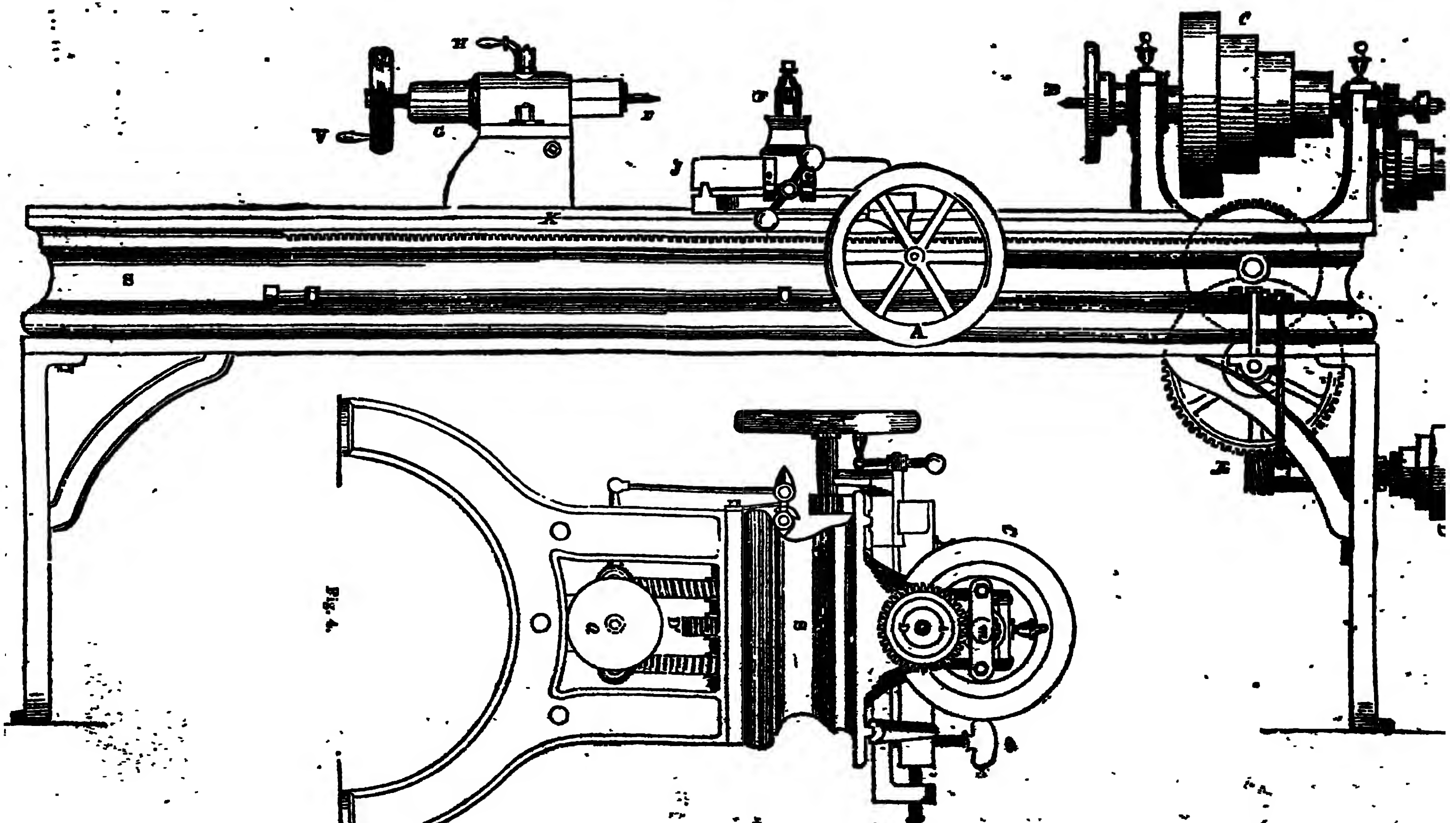


Fig. 4.

shaft there is a pinion driving a gear on the shaft above, which has a chain-pinion, around which an endless chain passes attached to the rest. A is a hand-wheel for moving the rest by hand. There is a pinion on the other end of the hand-wheel shaft-gearing, with a rack K on the side of the bed, as shown at fig. 8; F is the tool-holder; J is the top part of the rest, which slides crosswise of the bed by means of the crank and screw; I is a square spindle, which is moved by the hand-wheel V and screw inside of shell G: it is held firm in its place by the handle-nut H; *a* is a

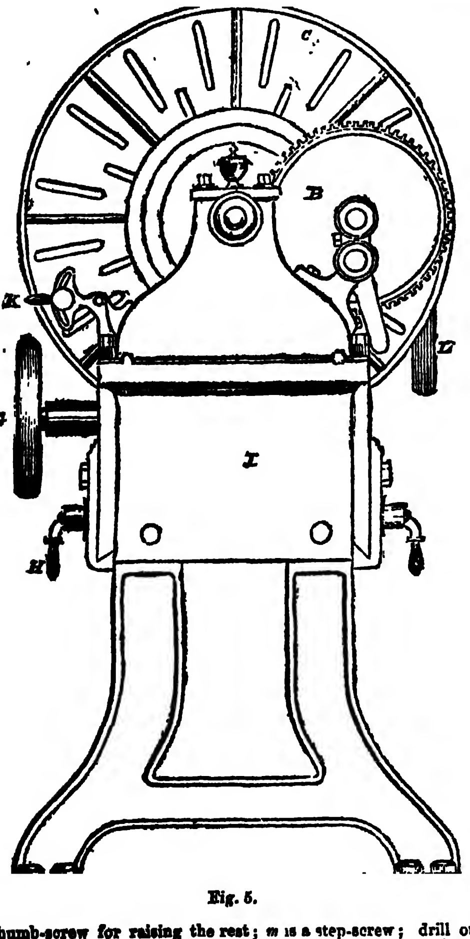


Fig. 5.

thumb-screw for raising the rest; *m* is a step-screw; *b* is a thumb-screw for adjusting the tool in the rest. This lathe will swing sixteen inches over the sills, and seven inches over the rest. A fine example of a boring and reaming-lathe is exhibited at Plate LXXV and at fig. 5. I is the main bed-piece supported by two cast-iron standards; D is the head-stock, which carries the spindle and cone-pulleys A; G is the sliding-frame which supports the rest P; this frame is traversed backward and forward by means of the hand-wheel R, which has a pinion on the other end gearing into the rack G on the side of the bed, as shown in Plate LXXVI., and is held down by the plates X, which hook under the slides S, and is secured by means of the nuts with handle H on each side: C is a face-plate on a live spindle, to which the work is fastened by bolts when drilling or reaming; F is a tail-stock with a travelling-spindle worked by the hand-wheel M, which turns a screw inside of the spindle in the usual way, for pressing in the drills, reamers, &c.; L is a hand-wheel on a screw, for setting the tail-stock so as to make a tapering hole; A are cone-pulleys on a spindle; U, gear on spindle; *b*, pinion on spindle, plying into gear B; B, gear on back-shaft, for reducing the motion of the spindle and increasing power, in the same manner as is common in geared head-lathes; K, handle for throwing the back gear-shaft out of or into gear. This machine is capable of boring out a hole three inches in diameter in a wheel three feet in diameter. At Plate LXXVI. and figs. 6 and 7, are shown drawings of an engine lathe, which is adapted to swing fifty inches in diameter over the ways, and thirty inches in diameter over the rest. Plate LXXVI. is a side elevation of the engine; fig. 6 is an end elevation; fig. 7 is a side elevation of the tail-stock. P represents the bed-piece, which supports the head and tail-stocks and rest; C is the head-stock, in which the live spindle runs: it is made in a saddle form, and very heavy, bolted to the bed-piece by six bolts; B B are the gears by which the motion of the spindle is reduced and the power increased; D D' are small cone-pulleys, for driving the long feed-screw which is on the inside of the bed-piece, and is shown in the drawing; O is the gear on the end of the feed-screw, driven by a pinion on the wheel of the lower feed-cone D'; A are cone-pulleys on the spindle of cast iron; is the face-plate with gear B attached to the b.e. ; K is the tool-holder, which slides upon a swivel-post (S), that can be set at any angle, and fastened by the lever and screw R to the block N, which slides cross wise of the bed-piece by means of the crank and screw, with a balance-bolt, seen in Plate LXXVI., and at N' in fig. 6; G is a hand wheel for traversing the rest by hand. This wheel runs on a stud with a pinion on its hub, which works into the gear H, H is placed on the end of a short shaft with a pinion (*h*) on the other end, gearing into the rack I, attached to the side of the bed. T is the main sliding-saddle plate for the rest; it is very heavy, permanently fitted to the slides and held down by pieces (J), and is well adapted to fastening on heavy work for boring, &c.; M is a lever for changing the direction of the feed, U is a handle for stopping and starting feed; L is the lower part of tail-stock, which is notched on the slides or ways of the bed-piece; Q is the upper part of the tail-stock, which is made to slide crosswise for tapering work in the usual way. Figs. 8 and 9 show a very convenient and useful tool for boring and reaming locomotive and car wheels, pulleys, gears, &c. It is adapted for turning out a hole straight or tapering, and to splice the same without removing it from the chuck. It is also adapted to turn or drill out holes, or to bore, by using the shell-boring tool; all self-feeding. Fig. 8 shows a side elevation of the machine; fig. 9 an end elevation looking towards the face-plate. A is a cone-pulley of cast iron, which runs on the live spindle; the spindle has strong journals running in gun-metal boxes; A' is a gear on the face-plate; B is a gear on the front shaft; *o* is a shaft which may be thrown out of and into gear by eccentrics; C is a face-plate, to which the work is fastened by means of bolts; D is the upper cone, for driving the feed-motion; D', lower cone on the splined shaft, through which the centre of the bed-piece, giving motion to the rack I, which can be connected with the spindle J by the screw on top; F is the head-stock, in which the live spindle rests;

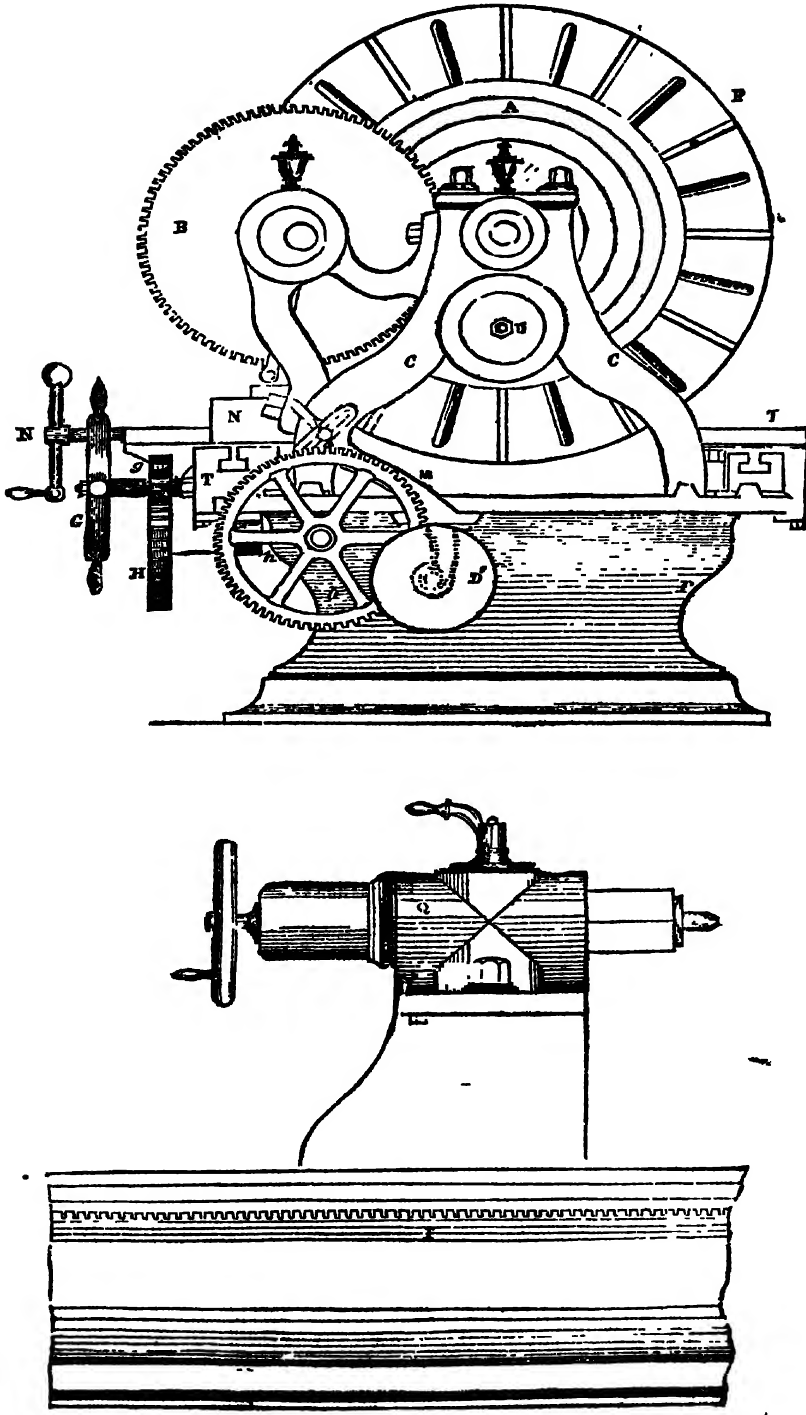


 Fig 7.

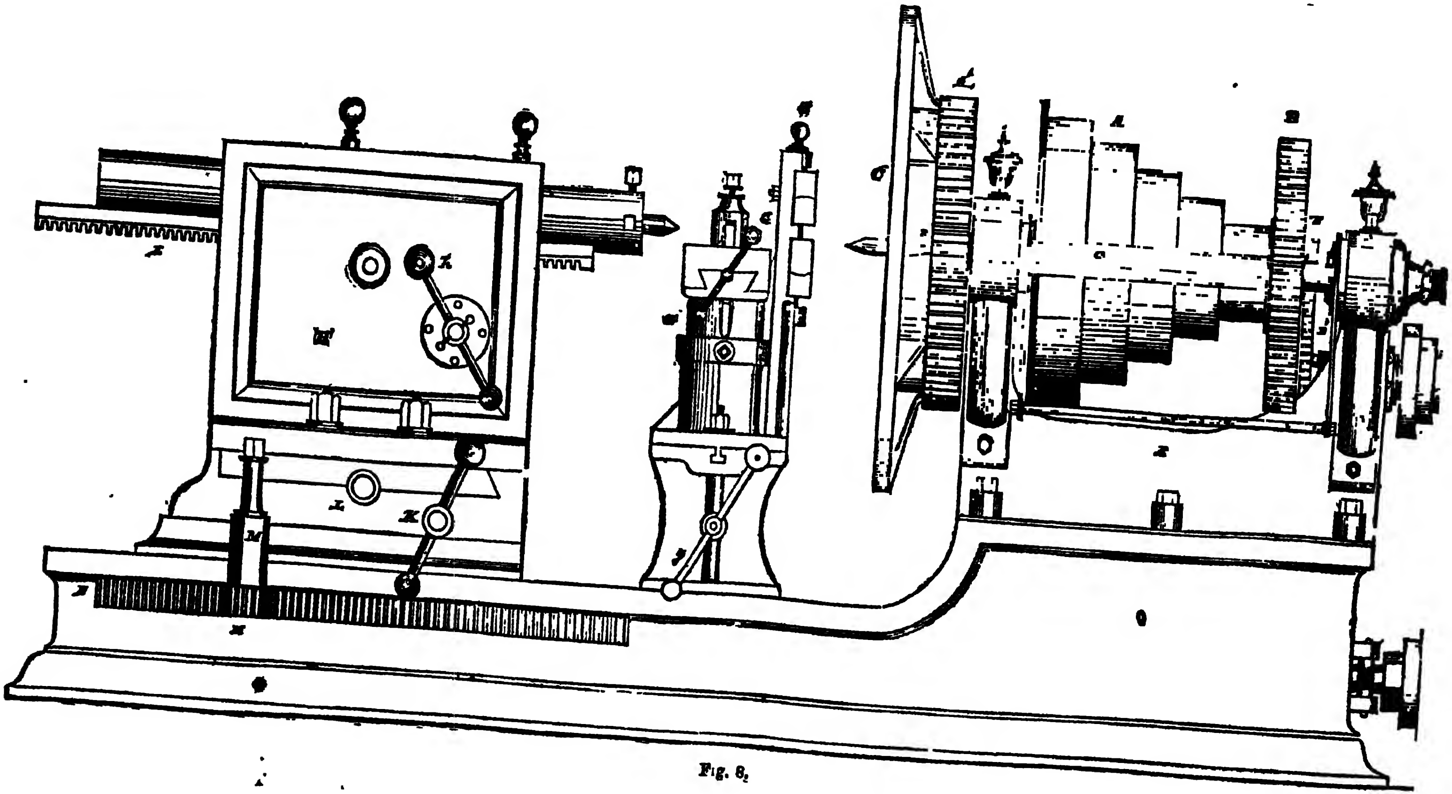


Fig. 8.

G is the swivel-post on which the tool-holder slides; *g* is the bed-piece on which G stands; G′ is a rest with jaws, for using flat drills and reamers, adjusted by the screw on top; H is the upper part of the tail-stock, inside of which is the feeding-apparatus: this piece rests upon a sliding-plate that is traversed crosswise by the screw L; S is a worm, which gears into a segment on the side of the tail-stock for giving the proper handle when a hole is to be turned out tapering; K is a crank, with a bevel pinion on the inside end of its shaft gearing into a large bevel-wheel that has an internal screw cut through its heel, for fastening down the tail-stock to the bed; M is a stand cast on the side of the lower piece of the tail-stock, carrying a shaft and pinion gearing into a rack on one side the lathe in place of the tool-holder for turning; *h* is the slide of the tool-holder; *i′* is a cogged sector working in the rack at the bottom of the drill of tool-holder; *i* is a shifting crank, to convey motion to the sector; E is a ratchet-wheel on the main mandrel of the lathe, to give motion to the gun on the centres while planing between the trunnions; D is an eccentric connection, to give motion to feed-hand; A are pulleys on bevel pinion-shaft. Fig. 10 shows a back (sliding) head, for turning or boring; *k* is a lever for throwing the head out of gear; *l* is a feed-screw; *n* are gibs. At *h*, fig. 13, is displayed a lever for throwing the slide-rest out of gear.; *f* is the feed-screw; *m* is a half-rest for feed-screw; *n*, *n* are gibs on slide-rest; *d*, fig. 14, is a pulley for drawing boring-bar; *e* is a

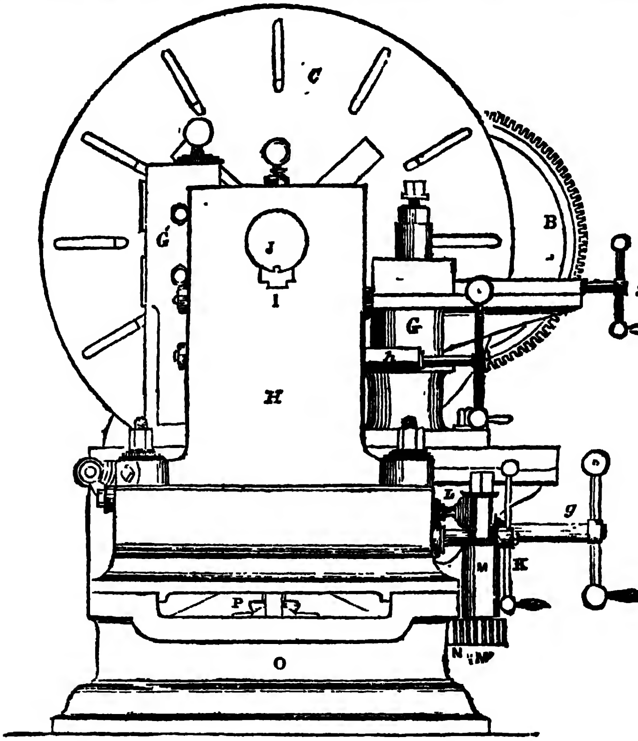


Fig. 9.

of the bed-piece, for the purpose of moving the tail-stock by hand; M′ is a pinion which gears into rack; N, a rack on the side of bed-piece; O, the bed-piece cast with cross-pieces, and made very strong. This lathe will admit a wheel 5½ feet in diameter, and is adapted for turning off the runs of pulleys and for surface-turning generally. Mr. W. M. Ellis, an American engineer, has arranged a lathe for gun-boring, turning, and planing, which has been adopted by the Ordnance Department of the United States navy-yard at Washington. The parts of this machine are shown at figs. 10 to 15, and at Plate LXXVII. *c*, at fig. 12, shows the rest for supporting the muzzle of the gun while boring; *d* is a pulley, with belt-motion above, for drawing boring-bar. When boring, the turning mandrel is taken out, and the boring-bar put in its place; the back head is forced up by feed-screws in the same manner as is a slide-rest for turning. C, Plate LXXVII., is a planing-head and tool-holder, bolted on the slide-rest of ratchet-wheel; *f* is a lever on ratchet-wheel for boring; *c*, fig. 11, is a planing-head for planing between trunnions; *h* is a tool-holder. Fig. 15 shows the standing-head; *b* is the feed-gear, the same as in fig. 12; *g*, the handle for changing the feed-gear. Mr. Charles Walton, of Leeds, has invented a most efficient self-acting and screw-cutting lathe, which, as it is characterized by many ingenious and instructive details, we will here describe minutely:—Fig. 1, Plate LXXVIII., is a general side elevation of the lathe; fig. 2 is a plan corresponding; fig. 3 is an end elevation, showing the gearing; fig. 4 is a transverse section taken between the fast-head and the slide-rest, showing the latter in elevation, as also the arrangement of the gearing for traversing the same. Figs. 16, 17, 18, and 19 show details of the gearing for working the slide-rest; fig. 20 is an elevation of the top cone and driving-pulleys; these consist of two sets, the smaller set being used for reversing the motion of the saddle when the lathe is employed in screw-cutting, and the larger when the

tool is in action, and a slower motion consequently necessary. Fig. 21 is a section through the driving-cone on the lathe-spindle, fig. 22 is a front view of the chuck, fig. 23 is a side elevation of the same, and fig. 24 is a vertical section in the plane of the lathe-spindle. The foregoing figures exhibit in full detail the several parts of a very efficient, and in many respects, convenient self-acting and screw-cutting lathe. The machine is carried upon three standards, marked A, the general forms of which are shown at figs. 3 and 4, Plate LXXVIII. These standards are planed on their upper surfaces, to afford a solid rest for the bed B B, the upper surface of which is also planed. The exterior edges of the bed are bevelled in the usual way, as a means of retaining the saddle-plate of the slide-rest, as shown in the cross-section, fig 4, Plate LXXVIII. The fast-head C C is secured to the bed by means of bolts, it carries the main spindle D, upon which is the driving-cone a, a section of which, showing its relation to the spur-wheel c and pinion b, is the subject of fig. 21. The cone is as usual loose upon the spindle, and can be attached at pleasure to the wheel e, which is fast upon the spindle, when it is necessary to throw the back-speed shaft E out of gear. This is effected by the hand-rail G, which connects the two levers commanding the bearings of the shaft in the two standards of the fast-head, a method commonly adopted when the arrangement of the gearing does not conveniently admit of the shaft being shifted longitudinally. The motion of the leading-screw N is derived from the cone-spindle through the train of wheels w, x, y, z, in screw-cutting, and in plain work the parallel motion of the tool is obtained through the train v a' e' c and the band-pulleys b and e', to the traverse-spindle f' f', which, by means of the worm g, figs. 4, Plate LXXVIII., and 19, and worm-wheel i', communicates, through the intervening spur-pinions r and s with the pinion t, fig. 16, gearing with the toothed rack u, figs. 4, Plate LXXVIII., and 18, attached to the under-side of the saddle-plate L of the slide-rest. The gearing for reversing the motion of the saddle consists of three meter-wheels and the clutch-box k', arranged upon the traverse-rod f' f'. The clutch k' communicates, by means of a spanner fixed upon a horizontal shaft passing through the bed of the lathe, with the reversing-lever l' in front. By this means the shaft communicating with the train of wheels from the cone-spindle may be geared either directly with the traverse-rod f' f', or, through the intervention of the meter-wheels, at pleasure. A weighted lever (j), shown in fig. 4, Plate LXXVIII., serves the purpose of throwing the worm-wheel i' in or out of gear with the worm upon the traverse-rod, thereby connecting or disconnecting the lathe with the saddle of the slide-rest, as may be required. The slide-rest can be relieved from connection with the leading screw N by means of the handle o, attached in front of the saddle. By pressing this handle down, it acts upon a stud in the plate carrying the screw-box n, which is thereby opened, and the saddle relieved. The movable head-stock J J is provided with a screw (f), for shifting it out of the line of the axis of the main spindle, thereby adapting the lathe to conical turning. The action of this excellent machine may be thus explained. The arrangement of the gearing in the views given of the lathe in the plates is that adapted to screw-cutting. The cone a, which is loose on the spindle, is fast to the pinion b, of thirteen teeth. This pinion gears with the wheel c, of fifty-two teeth, upon the back-speed spindle E, which

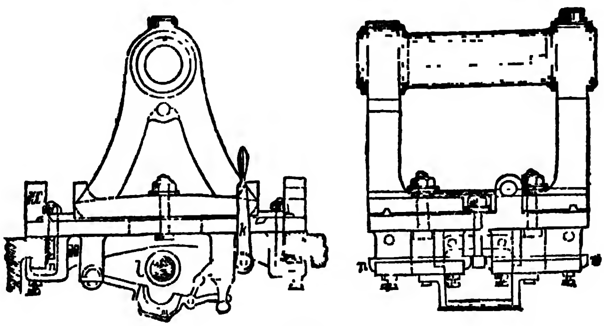


Fig. 10.

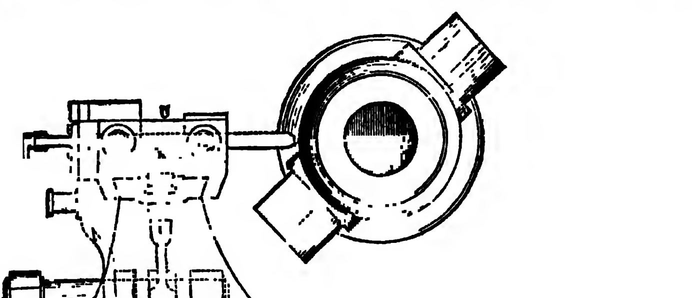
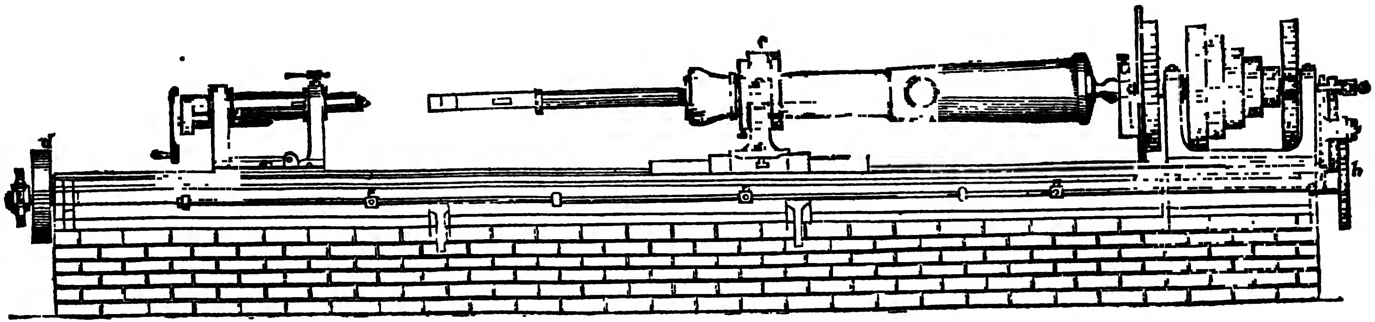


Fig 11.

Fg 12.



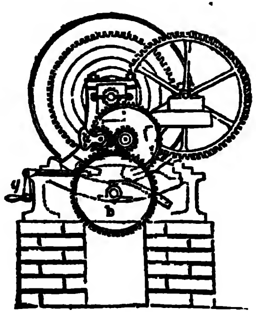


Fig. 15.

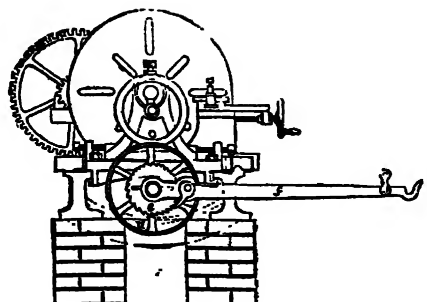


Fig. 14.

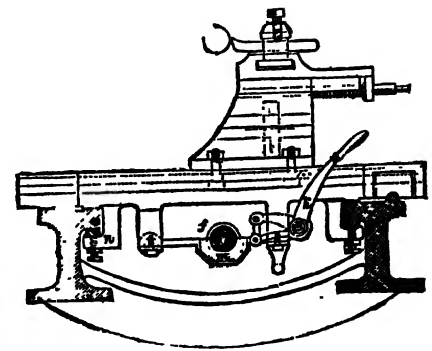


Fig. 13.

also carries the pinion *d*, of thirteen teeth, gearing with the wheel *e*, of fifty-two teeth, fast upon the cone-spindle D. According to this arrangement, the ratio of the speed of the driving-cone to that of the main spindle is as sixteen to one. The connection between the cone-spindle and the leading screw N is accomplished by means of the wheel *b* (of forty teeth), fast upon the driving-cone spindle: this wheel works into the wheel *w* (of sixty teeth), upon a shifting stud, attached by means of a radial slot-bar to the bracket O, bolted upon the fast-head; this latter wheel, again, is in gear with the wheel *x* (of ninety teeth), also upon a shifting stud, and carrying a wheel (*y*) of forty-five teeth, in gear with the wheel *z* (of ninety-teeth), fast upon the leading screw-shaft N. This train can, of course, be varied at pleasure, to suit the particular pitch of screw to be cut; the positions of the radial slot-bars, carrying the studs of the carrier-wheels, being at the same time shifted, to allow the wheels to come into gear. To adapt this lathe for plain sliding, the back-speed shaft is put out of gear with the cone-spindle by means of its handrail, G; the wheel *c*, upon the cone-spindle, then gears with the wheel *a'*, working loose upon a stud attached to the head-stock,

throwing the back-speed shaft in and out of gear with the cone-spindle; H is the free-plate, which is screwed upon the end of the main spindle; I is a bracket bolted to the outer standard of the fast-head (*see* D); J J is the movable head-stock. It is planed and fitted upon a saddle (K), both the upper and under surfaces of which are planed,—on the upper, to allow the head-stock to slide upon it transversely; and on the under, to allow of its being travelled on the bed of the lathe; L L is the saddle-plate of the slide-rest, which is planed and fitted with bevelled pieces, to retain it upon the bed of the lathe, as shown in fig. 4, Plate LXXVIII.; M is the tool-holder of the slide-rest; N is the leading-screw, carried in bearings at its two extremities, attached in front of the lathe; O, the bracket for carrying the train carrier-wheels by which the motion of the main spindle is transmitted from the leading-screw; P, in figs. 22, 23, and 24, shows the front plate of the universal chuck; and Q, the back plate of the same, showing the spiral groove for expanding and contracting the clutches or jaws; R, R, R, the clutches or jaws of the chuck. These are fixed upon separate soles, through which one of the tails passes, while the other passes over the

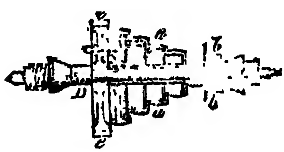


Fig 21.

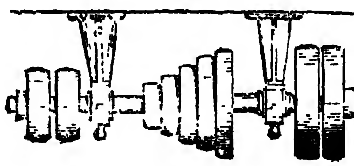


Fig. 20.

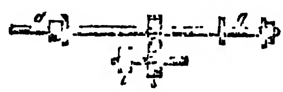


Fig. .

Fig. 24.

Fig. 23.

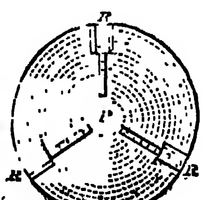


Fig. :

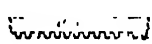


Fig. 18.

Fig. 17.

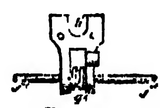


Fig. 19.

and carrying the cone-pulley *b*. This last is connected by a band with the loose cone-pulley *c'*, working likewise upon a stud fixed to the standard A, and carrying a wheel *d'*, which gears into the wheel *e'*, fast upon the end of the traverse-rod *f' f'*, on which are the three meter-wheels and clutch-box *k'*, also the sliding-worm, which works into the cone-wheel *i'* upon the shaft *q*. This shaft revolves in bearings attached to the saddle, and carries the pinion *r*, f[illegible] into the wheel *s*, keyed upon the same spindle which carries the pinion *t*, also fast. This latter gears with the rack *u*, bolted to the under surface of the saddle. By this arrangement motion is transferred from the cone to the traverse-rod *f' f'*, and thence to the slide-rest through the gearing attached to the saddle. The working of this excellent engine will be more fully understood by a reference to the following:—A, A, A are the standards upon which the lathe is supported; B B is the bed, or shears having the upper ledges, upon which the shifting head-stock and saddle rest placed; C C is the fast-head, which is firmly bolted upon the bed; D is the same spindle, which is highly finished and case-hardened. It revolves in conical collar of hardened steel, and is further secured against end-long shift by a set screw bearing against its outer end through the bracket I; E is the back-speed shaft, revolving in bearings inserted in the projecting lugs F. F, cast on the standards of the fast-head; G is a hand-rail for

inner end of the sole; these tails slide between the radial slots in the front plate P, and enter the spiral groove formed in the face of the back plate Q. When the back plate is turned upon its axis, which coincides with the axis of the main spindle, the front plate being meantime held fast, the clutches or jaws will be guided simultaneously farther from, or nearer to, the centre, and thereby made to clutch the work in the usual way. *a* is the driving-cone of the lathe, it is loose upon the main spindle, and fast to *b*, the first pinion of thirteen teeth; it is fast to the driving-cone *a*; *c* is a wheel of fifty-two teeth, on the back-speed shaft E, and *d* a pinion of thirteen teeth, on the same shaft; *e* is the first wheel (of fifty-two teeth) on the main spindle of the lathe; *f* is the screw for moving the loose head-stock transversely for conical turning: *g* is a hand-wheel for working the spindle of the loose head-stock; and *h* a handle for tightening the pinching-screw of the same; *i* is an adjustable check, by which the slide-rest M is retained upon the saddle-plate L; *j* is a rest-plate for the tool-carrier; and *k* a screw for fixing the tool-holder upon the side-rest; *l* is a hand-wheel and handle upon the end of the transverse screw of the side-rest. This screw works in plain collars attached to the saddle-plate, and in a nut attached to the sliding-sole of the rest, so that the screw being turned, it carries from or towards the axis of the lathe; *m* is a crank-handle upon the upper

slide-screw, for putting the tool in and out of cut; n is the screw-box for the leading-screw. The under part is screwed internally to the same pitch as the leading-screw, and is carried upon a sliding sole, into which is inserted a stud, passing through a slot, n; o is a handle for connecting and disconnecting the screw-box of the leading-screw. It acts as a lever of the second kind, the stud of the sliding-sole of the nut passing through a slot in it between the fulcrum and the part acted on by the hand; p is the crank-handle for working the saddle-plate by hand; it is placed upon g, the transverse shaft, upon which is the screw-wheel i', working into the sliding-worm g', carried along the rod $f'\ f'$ by a fork (h') attached to the saddle-plate; r is a spur-pinion keyed upon the transverse shaft g, and working into s, a small spur-wheel keyed upon a short spindle, attached by bearings on the bottom of the saddle-plate, and which gears with the pinion r on the transverse shaft q; t is a spur-pinion keyed on the same spindle as s, and which gears with u, an inverted rack, fast to the bed of the lathe; v is the first pinion in the head of the trains of the head-gearing of the lathe; w is a carrier-wheel, which gears with the pinion v; it is loose upon a stud in the stud-plate O, x is a second carrier-wheel upon another stud in the stud-plate O, gearing with the former; y is a third carrier-wheel, on the same stud as the wheel x, and made fast to the latter; z is a keyed wheel upon the end of the leading-screw, and gearing with the pinion y. It is through this train that the leading-screw derives its motion from the main spindle of the lathe; a is a wheel of the back-train gearing with the pinion v, on the end of the main spindle; it is keyed upon b, the upper cone of the back-train, carried upon a stud in the standards of the fast-head. It is loose upon the stud, and has the eye prolonged into a pap, upon which the wheel a' is keyed; c' is the lower of the two cones of the back-train. It is also loose upon its stud, and is connected by a band with the upper speed-cone b'; d is a spur-pinion, keyed upon the eye of the speed-cone c', which is prolonged for that purpose, and which gears with e', a spur-wheel on the end of the worm-shaft $f'\ f'$, gearing with the pinion d'; $f'\ f'$, the traverse-rod or worm-shaft, a grooved rod passing at the back of the lathe, and having its bearings at the two extremities. It is also supported between by the fork which slides the worm g' along upon it, the projecting sides of which are formed into a species of double gallows, as shown in figs. 4, Plate LXXVIII., and 19. g is a worm, or endless screw, upon the traverse-spindle, gearing with the worm-wheel i'. It has a fixed key in the eye, which slides in a groove in the rod $f'\ f'$, i is a worm-wheel on the end of the transverse shaft q, worked by the worm g'; j is a weighted lever for disconnecting the worm-wheel i', k shows reversing-gear upon the worm-shaft $f'\ f'$, consisting of the three meter-wheels and clutch-box, arranged in the usual manner, and worked by l', the lever of the reversing gear k'; it acts by a spanner upon the clutch-box lever, bringing the clutch into gear with either of the wheels upon the worm-shaft at pleasure. A few years since, Messrs. Perkins & Heath invented two superior machines for engine-turning, in which rosettes are dispensed with, and their place supplied by an eccentric wheel or cam, which produces one wave only; but by means of toothed wheels as many of these waves as are requisite are introduced during each revolution of the mandril. This engine produces an immense variety of patterns, with the very great advantage of all the waves being precise counterparts of each other. Work of this description is generally cut with a diamond, as a steel tool is liable to break or get dull, and destroy the uniformity of the work.—(*English Cyclopædia*—Arts and Sciences.) The student of practical mechanics may turn with advantage to the second volume of Appleton's *Dictionary of Mechanics*, where, under the head of "Lathe," he will find many excellent modern forms of lathes for various uses. In particular, there are figured and described these:—A back-gear turning-lathe; a lathe for boring and turning, which is specially well fitted to face heavy pieces of work, as well as the boring of cylinders; a boring-mill and large turning-lathe, an indispensable machine in works where engines of large class are constructed; and, finally, a modification of the reaming and boring-lathe we have already described. This latter tool is used in the vertical boring-mill constructed at the Washington Navy-yard, by Mr. W. M. Ellis. The best and fullest account hitherto published on the lathe and its mode of working is to be found in the treatise on "Turning and Mechanical Manipulation in General," by Mr. Holtzapfel.

LATIN CHRISTIANITY is that system of Christianity which was established among the nations of Western Europe. Christianity may be said to have been originally a Greek religion. Greek was the commercial language of the Jews among whom it was first disseminated; its primal records were all, or nearly all, written in the Greek language; it was promulgated with the greatest rapidity and success among nations either of Greek descent, or of those who had been Grecised by the conquests of Alexander; its most flourishing churches were in the Greek cities. Greek Christianity was eminently speculative in its tendency. For centuries it continued to be agitated by those primary questions that lie at the bottom of all religions—the formation of the world, existence and nature of Deity, the origin and cause of evil. It was by no means aggressive, and achieved few conquests. Latin Christianity, on the other hand, seemed endowed with an inexhaustible principle of expanding life. It was constantly pushing forward its frontier, and advancing into the strongholds of northern paganism. Gradually it became a monarchy, with all the power of a concentrated dominion. It was, in fact, the Roman empire again extending itself over Europe, by a universal code and a provincial government; by a hierarchy of religious prætors or proconsuls, and a host of inferior officers, each in strict subordination to those immediately above them, and gradually descending to the very lowest ranks of society. The clergy assumed an absolute despotism over the mind of man. Not satisfied with ruling princes and kings, themselves became princes and kings. They were a second universal magistracy, exercising always equal, asserting, and for a long period possessing, superior power to the civil government. They had their own jurisprudence—the canon law,—co-ordinate with, and of equal authority with, the Roman, or the various national codes; only with penalties infinitely more terrific, almost arbitrarily administered, and admitting no exception, not even that of the greatest temporal sovereign. In the Latin church, Latin was the religious language, the Latin translation of the Scriptures the religious code of mankind. Latin theology, for the most part, left to Greek controversialists to argue out the endless transcendental questions of religion, and contented itself with resolutely embracing the results which she fixed in her inflexible theory of doctrine. The only controversy which violently disturbed the Latin church was the practical one, on which the East looked almost with indifference,—the origin and motive principle of human action,—grace and free will. This, from Augustine to Luther and Jansenius, was the interminable still revolving problem. Latin Christianity was the religion of the western nations of Europe for a period of at least ten centuries. It maintained its unshaken dominion until what may be called Teutonic Christianity, aided by the invention of paper and of printing, asserted its independence, threw off the great mass of traditionary religion, and, out of the Bible, summoned forth a more simple faith, which seized at once on the reason, the conscience, and the passions of men.—*Ref.* Milman's *History of Latin Christianity*, 1854.

LATIN LANGUAGE AND LITERATURE.—The Latin language, the speech of the ancient Romans, derived its name from the country of Latium, the central region of Italy. Latium was surrounded, in the south by colonies of Greeks, by the Tyrrhenian Pelasgi on the plain of the Po, by the Ligurians at the foot of the Alps, by the Umbrians and the Ausonians on the Tiber, the Oscans at the foot of Vesuvius, and the Etruscans on the Arno. The territory of Latium, therefore, having Greeks on the one side and barbarians on the other, overrun in turn by both, and at last peopled by different tribes, gave rise to a language partaking of various elements. Many of the Latin words are of Greek derivation, a number of which are probably simple transplantations, adopted after the language was formed, but there are many others that have been

more or less changed; and probably not a few that were originally Greek have come to lose all traces of their origin. The terms of husbandry and domestic occupation are mostly Greek, while those of warfare, on the contrary, are evidently not Greek. Hence it is concluded that the indigenous Pelasgi were subdued by victorious invaders. This view is confirmed by the fact, that the terms for the simplest ideas are Greek; as, *sto*, I stand; *sedeo*, I sit; *maneo*, I remain; while the terms referring to government and laws do not appear to be Greek; as, *rex*, a king; *jus*, law; *civis*, a citizen. Words relating to religion are usually not Greek, and may have been furnished by the Etruscans. That the conquerors did not come by sea is indicated by the fact that most of the maritime terms are Greek. As the Romans became masters of Italy, the other languages of the country disappeared. During the period preceding the first Punic war, the Roman language was in no settled state. It was necessarily exposed to a mixture of various idioms, from the diversity of foreigners who composed the early population of Rome. It was not until the close of that period that any attention was paid to the regular settling of the principles and forms of the language, and not until a still later time that any approved author laboured upon the cultivation of style. Traces of the old forms of the language are found in fragments of the earliest poets, and also in the comedies of Plautus. The Latin language has only twenty-three letters, corresponding to those of the English, except that *w* is entirely wanting, that *i* was used to represent both *i* and *j*, and *u* to represent both *u* and *v*. Distinctive forms for these letters were not introduced until the middle ages. The letter *k* seldom occurs, and *y* and *z* exist only in a few Greek words, and came late into use. X is also a letter of late origin; and, at an early period, *i* was used instead of *y*, and *ss* instead of *z*. There is no article in the Latin language, a defect which frequently gives rise to ambiguity. The characters used in writing greatly resembled, in the earliest period of the language, those of the Greek. The Romans used only capital letters, and, on account of the inconvenience in rapid writing, they formed abbreviations, by using the initial letters, or some of the principal letters of a word. Until the time of the poet Livius Andronicus, who flourished about 240 B.C., there exist few monuments of the Latin language. The oldest of them is a hymn, which was chanted at their annual festival, by the *fratres arvales*, a college of Roman priests. It was dug up at Rome in 1778, and is believed to be as old as the time of Romulus. It contains but few words that remained in the language. The next specimens belong to the time of Numa, and are the Salian hymn, which was unintelligible to Horace, and the laws of Numa; after which come the laws of the Twelve Tables, about B.C. 450. After the Romans had conquered the south of Italy and Greece, Greek terms and phrases were grafted on the old Latin stock, and the language lost much of its original form. What, however, it lost in originality, it gained in refinement and polish; so that its golden age dates nearly from this transformation,—from the death of Sylla through the reign of Augustus. The progress of the Romans in the arts and sciences during this period has excited the admiration of posterity, and secured them a rank among the distinguished nations of antiquity second only to the Greeks. They had seen their inferiority in these respects to the Greeks, and had been brought to admire and copy their poetry, oratory, and works of art. Much, too, was owing to the comparative tranquillity which they enjoyed during this period, and the protection and encouragement which was afforded to them. The language of the upper classes (*lingua nobilis, classica*) was distinguished from that of the common people (*lingua plebeia, vulgaris*), the latter of which is only preserved to us in a few phrases in the comic poets. There was also a *lingua urbana* distinct from the *rustica*, as well as a *lingua provincialis*. After ..eath of Augustus, the language became more and ..corrupt, by the introduction of foreign terms ..a almost every language with which the people came in contact. The degeneracy became more rapid after the time of the Plinys, as there was no writer capable of moderating it. The successive incursions of the Goths, Vandals, and Lombards flooded it with foreign words and forms. That the Latin language did not share the destruction of the Roman empire was due to Christianity, which had adopted it; and though it at first deteriorated it, it afterwards secured its perpetuity. It remained, in Europe, the ecclesiastical, political, and official language, long after it had ceased to be spoken, except in cloisters. At the revival of letters, Latin was the common language of the savants of Europe, and was written by many of them with great ease and purity. Bacon wrote the principal of his works in Latin, believing that it was destined to be the universal and common language of learned men. The Reformation was a great blow to the general use of the Latin language, by depriving it of its prestige and authority, and exalting the vernacular languages above it. Still, however, even in the present day, many learned works are produced in Latin, particularly in Germany and Holland. The Romans being chiefly devoted to war, politics, and legislation, for five centuries were possessed of no literature worthy of the name. From the first it was an imitation of that of Greece, and hence its general characteristics are correctness and precision, with little of the buoyant vigour and various colouring of original genius. Even in its most cultivated period, the poets seem to have had little conception of originality, except as the importation of a new style from Greece. It was not till after the Romans had conquered Magna Græcia and Sicily, and had thus become intimately acquainted with Greek literature, that they began to turn their attention to that subject. Their first poet was Livius Andronicus, a Greek taken at the capture of Tarentum, and who produced Latin tragedies and comedies, translated from and modelled after the Greek. The poet Ennius (B.C. 239—169) was regarded by the Romans as the father of their poetry. He wrote tragedies, satirical and didactic poems, and the "Annales," an epic on Roman history, for which he was the first to use the Latin hexameter. Distinguished as tragic poets about this time, were Pacuvius, the nephew of Ennius, and his contemporary Attius. Next follows the comic poet Plautus, whose plays, though rather of a low and coarse nature, abound in genuine touches of wit and humour, and were much admired. Under Terence (195—159) Latin comedy rose to its highest, though not to Attic excellence. His comedies are all translated or adapted from Greek sources, chiefly Menander, and are distinguished for the elegance and purity of their style. He sought to delineate the pathetic as well as the ridiculous features of daily life; and though inferior to Plautus in native vigour, he surpassed him in constructive talent and depth of feeling. Nearly contemporary with him were Novius and Pomponius, authors of popular farces; Cæcilius Statius and Afranius, who introduced Roman instead of Greek manners upon the stage. Lucilius (148—103), a patrician by birth, gave to literature the advantage of his rank as well as genius, and was regarded by the Romans as the father of satire, a style of poetry in which he eminently distinguished himself. The Romans, after this period, had no distinguished dramatic writers; their pieces were mostly translations or imitations of Greek works. The later tragic writers of the Augustan age, Asinius, Pollio, Varius with his Thyestes, and Ovid with his Medea, are praised, but they were never very popular. The ten tragedies which are ascribed to Seneca were never acted, and are too bombastic and rhetorical to please cultivated minds. The first rude annalists of Rome were Q. Fabius Pictor and L. Cincius Alimentus, who were succeeded by the elder Cato (234—149), author of the "Origines" of Rome, a work now lost. The last historian of importance in the pre-Augustan period of Roman literature, was L. Cassius Hemina, who wrote five or six books of "Roman Annals," fragments of which are still extant. Pre-eminent among the numerous other authors of this period were L. Cælius, Antipater, Cn. Gellius, Bablius, Sempronius, Asellio, C. Junius, Piso Frugi, Scaurus, Rufus, Catulus, Sylla, Valerius Antias. Distinguished among the orators who flourished before the time of Cicero were Sulpicius, the two Gracchi,—whose speeches were stated to have been learned and majestic,—Catulus, Crassus, Hortensius, and Antonius. Jurisprudence, as well as oratory, was suited to the genius of the Roman people;

and among those most distinguished for their legal acquirements were the elder Cato, the Scævolas, and Manilius. The Stoical philosophy had many partisans the first famous disciples of which being Panætius and Rutilius Rufus. The golden age of Latin literature is usually reckoned from the death of Sylla to that of Augustus (B.C. 78—A.D. 14). It was then that the influence of Greek learning and Greek philosophy came most to be felt. A knowledge of Greek was an essential part of a liberal education, and it was usual for the young men of means to finish their education by a residence of some time in Greece. In this period was Virgil (B.C. 70—19), one of the greatest epic poets that ever lived, and whose great work the "Æneid," has ever been admired for its elegance and taste not less than for its genius. It represents the landing of Æneas and the foundation of his dominion in Latium, and although the poet did not live to give it his finishing touches, and desired it to be destroyed, yet it will ever remain a noble monument of his great genius. More perfect of its kind is his "Georgics," a treatise of agriculture in the form of a didactic poem, and exhibiting his views and feelings respecting human life. His earlier Eclogues or pastorals manifest the same love for nature and a country life. Few writers have exerted so wide an influence upon æsthetic culture as Virgil. His contemporary and life-long friend was Horace (B.C. 65—8), whose odes and epodes are models of skill and taste, and who introduced a number of new lyric metres. This poet is also eminent in satire, a species of writing original with the Romans, and which appears to have had a decided influence on the character of their literature. The works of Horace abound with maxims of practical wisdom and happy philosophical apophthegms; so that no classical author of antiquity is more frequently read or quoted from. Ovid (B.C. 43—A.D. 14) in imaginative power is scarcely surpassed by any other Latin poet. He was also possessed of a brilliant sportive wit, and great power of versification. Less generally and highly esteemed are Lucretius, the sublimest of didactic poets, whose "De Natura Rerum" served at once to illustrate the atomic theory of the world and the Epicurean system of morals, and to polish and enrich the Latin language; Catullus (born 87 B.C.), who introduced lyric poetry into the literature of Rome, and whose elegies and epigrams are admired for their simplicity, beauty, and unaffected imagery; Tibullus, who gave to the elegy its highest degree of excellence; and his successor Propertius (born about B.C. 51), an amatory poet, who is also learned, awkward, and obscure. The place of the legitimate drama was now occupied by the mime or melodramatic farce, in which the characters of common life were represented with the help of gesticulation and with low jests, for the entertainment of the populace. It was invented by Mattius, and acquired its greatest celebrity from Laberius and Publius Syrus, the latter of whom interspersed it with moral sentiments, expressed with great felicity; but it never reached the standard of an elevated class of poetry. The greatest master of Latin prose of this or any other period was Cicero, who, in fact, has given name to the purest Latin composition. He flourished B.C. 106—43, and distinguished himself as an orator so as to dispute the first place with Demosthenes. The orations of Cicero are remarkable for their copiousness and luxuriance of expression. He is master at once of the impassioned, the sublime, the pathetic, the grave, and the simple style, and has the art of adapting to every subject the appropriate form and the fitting hue of expression. He also rendered most important service to the intellectual cultivation of his countrymen by the introduction to them of the more elevated moral philosophy of the Greeks. Originally a follower of Plato, he often adopted the ethical lessons of the Stoics, or, when their excessive austerities repelled him, embraced those of Aristotle. The doctrines of Epicurus he rejected as injurious to men, and especially in their relation as citizens. His works also afford much information in regard to the history of ancient philosophy; as, for example, his Tusculan questions. Poetry, also, history, and the epistolary style, he touched only to adorn. His letters are admitted to be the most perfect specimens which the literature of Greece or Rome can produce. Next to him, as orators, were the accomplished Hortensius, the obscure Cælius Rufus, the cold, cautious, and accurate Lucinius Calvus, and especially Julius Cæsar (B.C. 100—44), whom his contemporaries believed to be capable of rivalling even Cicero in eloquence. Pollio, Corvinus, and Cassius Severus, were also distinguished in th [illegible]

[illegible] little inferior to Herodotus in charm of diction. The historian next to him, in respect of style, is Cornelius Nepos, whose "Lives" are models of style in biographical composition. Sallust (B.C. 86—34) approximated to his model Thucydides in richness and vigour of thought, and terseness of expression, though he marred his clear conception by an affectation of antiquated forms. His accounts of the Catilinarian conspiracy and the Jugurthine war are carefully prepared and ambitious works, always profound, though often partisan in their judgments. Livy (B.C. 59—A.D. 17), pre-eminently the general historian of Rome, excels in pictorial effect, surpassing even the Greeks in the liveliness and richness of his colouring, and the animation and spirit of his delineations. The work, however, is more picturesque than accurate, and marked more by patriotism than candour. His style commands the admiration of classical scholars; but circumstantial truth must be sought elsewhere. In what is termed the Silver age of Latin literature, from the death of Augustus to the accession of Hadrian (A.D. 14—117), everything is changed. Liberty had disappeared, and talent was made subservient to flattery, or to bombast and an affectation of wit. Every subject was rendered comic; prose and poetry were confounded, and new grotesque forms of expression were invented. The purity of the language was no longer maintained, and it became corrupted by barbarisms. Seneca, who, with great talents, was ambitious of shining by the brilliancy of his wit, the structure of his antitheses, and the general terseness and point of his style, contributed not a little to the degeneracy of the period. His various prose writings abound in moral sentences and maxims, but reveal the pride of a Stoic in a style full of literary affectation. Eloquence was cultivated by Julius Florus, by Domitius, and by Julius Africanus. Plays were produced by Pomponius Secundus, Varginius, and Martinus. The epic degenerated from poetry to history; the "Pharsalia" of Lucan, the greatest effort in this line, being rather declamatory than poetical. Valerius Flaccus, author of the "Argonautica," a work neither original nor brilliant, introduced an affectation of learned display. To this period belong Silius Italicus, author of "Punica;" Statius, author of "Thebais;" and Manilius, author of "Astronomica." In satire this period is more distinguished. Persius and Juvenal are the chief masters of this art,—the latter disputing the palm of superiority with Horace. Martial first gave to the epigram its present meaning, as a short poem, in which all the thoughts and expressions converge to a striking and unexpected conclusion. His twelve books of epigrams exhibit a singular flow of wit and fertility of imagination, and afford much information regarding the social habits of the people. In prose, Paterculus ranks among the best authors of this period. His work on Roman history is elegant and elaborate, and is conceived in an impartial spirit, though it manifests an opposition to republicanism, and a tendency in favour of the empire. The greatest of Roman historians, however, is Tacitus, who, to great powers for observation, unites intellectual strength; and whose experience of men and affairs furnishes the most sombre colours and sagacious maxims. He displays great acuteness in penetrating into the inner nature of men, exposing their hidden motives of action, their cunning, servility, immorality. With eloquence derived from indignation, and with a skill in graphic representation, such as only Thucydides and Sallust have given us examples of, he wrote a narrative of his time. Not to be compared with him, are Suetonius, the arid biographer of the emperors; the florid panegyrist Florus; Valerius Maximus, a collector of anecdotes; and Quintus Curtius, the Roman historian of Alexander the Great. Quintilian (born A.D. 40), in his great work "Institutiones Oratoriæ," displays a highly-cultivated mind and a polished and graceful style. He

attempts to restore eloquence to its former position, and lays down rules for the training of the orator. The elder Pliny displayed a great love for the study of nature, and drew attention to the physical sciences, which previous to his time had been entirely neglected. The letters of the younger Pliny are of much value for the light they throw upon the period in which they were written; but many of them are ridiculously studied and elegant. The Brazen age, from the accession of Hadrian to the fall of the Western empire (A.D. 117—476), exhibits not only the decline of taste, but the corruption of the language. The intercourse of the Romans with barbarians became much more extended. Under the Antonines, especially, the language became overlaid with exotic words, phrases, and constructions. Literature was also cultivated at Byzantium, Alexandria, Milan, and the principal cities of Gaul, as well as at Rome. As the literature declined, and the language became corrupt, the number of grammarians increased; for classical Latin had become almost a dead language, to be learned only from the ancient models. Ausonius, a grammarian, rhetorician, and poet, wrote idyls and epigrams marked by learning and wit; Claudian wrote epical sketches; Aurelius Prudentius, the greatest of primitive Christian poets, wrote a great variety of hymns and lyrical and heroic pieces, portions of which are still employed in the services of the Catholic church; St. Ambrose wrote Latin poems, remarkable for their austere simplicity and sublimity. The decline of prose appears in the "Historia Augusta," a collection of imperial biographies from Hadrian to Diocletian. The summaries of Aurelius Victor, Eutropius, and Sextus Rufus, succeeded. Almost the last noteworthy Roman history was that of Ammianus Marcellinus, extending to A.D. 378. The grammarian Cornelius Fronto, and the rhetoricians Apuleius and Ennodius, are the best of their class. The "Golden Ass" of Apuleius is almost the only example in Latin literature of anything like a prose novel or romance. The church fathers, as Tertullian, Minucius Felix, St. Cyprian, Arnobius, Lactantius, St. Hilary, St. Ambrose, and St. Jerome, are generally more remarkable for theological vigour than literary grace. In the reign of Justinian was drawn up that admirable system of laws which bears the imperial name. (*See* JUSTINIAN'S CODE.) Aulus Gellius, Nonius Marcellus, Festus Donatus, Macrobius, Servius, Priscianus, Cæsariensis, and Isidore of Seville, continued to cherish its traditions by criticisms, analyses, and such like. Maternus wrote on mathematics, Frontinus and Vegetius on strategetics, Palladius on rural economy, Solinus Publius Victor and Vibius Sequester on geography and cosmography.—*Ref.* Dunlop's *History of Roman Literature*, 3 vols., 1828; Bahr's *Geschichte der Röm. Literatur*, 2 vols., 1844-45; Bernhardt's *Grundriss der Röm. Literatur*, 1850; Eschenburg's *Classical Literature*, 1844; Browne's *History of Roman Classical Literature*, 1853; *The New American Cyclopædia*, 1860.

LATISSIMUS DORSI, *lät-is'-se-mus dor'-si* (Lat. *latissimus*, broadest, and *dorsum*, the back), in Anat., is the name of a broad flat muscle of the back, which serves to move the humerus downward and backwards, and to turn it upon its axis.

LATITUDE AND LONGITUDE, *lät'-e-tude* (Lat. *latitudo*, breadth; *longitudo*, length).—Latitude and longitude are the means by which the exact position of any place on the earth's surface, or any star in the field of the heavens, may be determined and described; but latitude and longitude in geography are not identical with latitude and longitude in astronomy, and the terms will require a separate definition, according to their acceptation in each science. In Geog., the position of any place on the earth's surface is indicated by the intersection of two imaginary circles at right angles to each other, one of which is a great circle passing through the place itself and the poles perpendicularly to the plane of the equator; and the other, the equator itself, if the place happen to be situated on that line, or a circle, the plane of which passes through the place in question in a direction parallel to the plane of the equator. Of these circles, the former shows the degree of longitude on which the place is situated, and the latter the degree or parallel of latitude. Longitude is measured along the equator, E. and W. of the meridian of Greenwich, from 0° to 180°, while latitude is measured N. and S. of the equator, from the equator to the poles, on any great circle that is perpendicular to the plane of the equator, from 0° to 90°. Longitude may also be described, in other words, as the angle contained between the plane of the meridian of any place and the plane of the meridian of Greenwich, which intersect in the earth's axis; and latitude as the angle that is subtended at the earth's centre by the arc of the meridian, or great circle, which is intercepted between the position of any place on the earth's surface and the equator. This is not strictly true, however, as far as latitude is concerned; as the earth is a spheroid in shape, and not an exact sphere (*see* EARTH, DEGREE, GEODESY); but, in the construction of maps and globes, and for all practical purposes of an ordinary nature, the difference is not appreciable; and as this angle, for any position on the earth's surface, would be equal to the altitude of the pole of the heavens at that place, the latitude of any place is usually determined by ascertaining the altitude of the pole at the place in question, wherever it may happen to be. In Astron., the latitude of any star is its angular distance from the ecliptic measured on a great circle, the plane of which passes through the star and the poles of the heavens; or it may be defined as the arc of this great circle that is intercepted between the position of the star and the ecliptic, while its longitude is the angle made by the inclination of the planes of two great circles which intersect in the axis of the heavens, one of which passes through the star and the poles of the heavens, and the other through the poles of the heavens and the intersection of the equator and the ecliptic at the vernal equinox; or, in other words, the arc of the ecliptic intercepted between the planes that pass through the star and the first point of Aries, and the poles of the heavens, at right angles to the plane of the ecliptic. In astronomy, therefore, the longitude of heavenly bodies is measured along the ecliptic instead of along the equator, as in geography; and celestial longitude is reckoned all round the ecliptic eastward in one direction, from 0°, or the first point of Aries, to 360°. It should be said that, in astronomical writings and calculations, the longitude of places on the earth's surface is reckoned and noted in the same manner, and not E. and W. of Greenwich, as in geography. The positions of the heavenly bodies are not now determined by latitude and longitude, but by their right ascension and declination. (*See* ASCENSION, RIGHT, DECLINATION.) The determination of latitude and longitude of any place on the earth's surface is effected by calculations based on observations of the positions of the heavenly bodies, with accurate instruments; the latitude of any place being, as it has been observed, the altitude of the pole of the heavens at that place, and the longitude, the difference between Greenwich time and the time at the place itself at the same instant. The methods of determining the latitude of a place are various. The following is generally adopted at fixed observatories, especially in Europe, where the pole is situated high in the heavens, and circumpolar stars are far above the horizon, and it is effected by means of accurate transit, mural, or altitude and azimuth circles. The precise situation of the pole is found by observing the altitudes of stars which are close to the pole, and describe small circles round it, at their culminating points above the pole and below it. When these observations have been duly corrected, the position of the pole, which lies midway between the culminations of the star above and below it, may be determined, and its altitude, and consequently the latitude of the place, may be found. This is a method by which the latitude of a place is determined independently, that is to say, without reference to known data of the positions of stars which have been ascertained elsewhere. In determining latitudes at or near the equator, the altitudes of the sun must be observed, both before and after either the summer or winter solstice, from which the altitude of the point midway between them, which lies in the equator, may be deduced, and the latitude determined. There are other methods by which the latitude of a place is determined differentially, as it is termed, in which the use of data of the polar distances of stars ascertained at other observatories is involved,

and the polar distance of the zenith, which corresponds to the co-latitude of the place, is ascertained from observations of the meridian zenith distances of stars which pass near the zenith, and of which the polar distances are known. This is effected by means of the zenith sector, and there are other methods of obtaining the latitude differentially, in which the transit instrument, the repeating circle, and Troughton's reflecting circle, are used; but it is beyond the compass of the present work to describe the *modus operandi* in each case *seriatim* At sea the latitude is sometimes obtained by taking the altitude of the sun above the visible horizon when on the meridian, by means of a sextant, and sometimes recourse is had to observations of the moon, the planets, and some of the more brilliant stars, when on the meridian. The method employed will be found in detail in any work on navigation. With regard to the determination of the longitude of any place on the earth's surface, as it may be known as soon as the difference between Greenwich time and the time at the plac[illegible] question has been ascertained, it is manifest that these two points must be known before its longitude c[illegible] be determined. The time at Greenwich may be known by reference to the chronometers, which are always carried on board ship for this purpose, and by persons who are engaged in expeditions for the advancement of the sciences of astronomy and geography, the chronometers being accurately set a[illegible] to Greenwich time prior to leaving England, but Gre[illegible] time may also be ascertained astronomically from the observation of such phenomena as the eclipses of Jupiter's satellites (*see* JUPITER), solar eclipses, and the occultations of fixed stars by the moon, as tables of these phenomena, including the occultations by the moon of all fixed stars to the sixth degree of magnitude, are noted in the "Nautical Almanac," according to the time at which they would take place at Greenwich. As soon as the commencement of any of the phenomena that have been mentioned is remarked, Greenwich time is known on reference to the almanac, and may be preserved by setting a watch to the hour indicated Another method of finding the longitude of a place consists in taking observations of the transit of the [illegible]oon and certain stars, which l[illegible] parallel of declination, across the [illegible] transit instrument. The stars which should [illegible] served with the moon, to afford the means of correcting the moon's transit, are noted in the "Nautical Almanac," as well as the variations in the right ascension of the moon for an hour of longitude The right ascension of the moon having been ascertained, which will be less than its right ascension at Greenwich if the place be east of Greenwich, and greater if west, the difference between the right ascension at each place must be obtained, and the result divided by the variation in an hour of longitude, which gives the longitude of the place in hours and decimal parts of an hour. At sea, where a transit instrument cannot be used, the longitude is found by taking lunar observations,—that is to say, by observing the distance of the moon from the sun, or any of the planets or fixe[illegible] by means of a sextant. These distances are calculated and registered in the "Nautical Almanac" for every successive interval of three hours, according to Greenwich time, by which the observer is enabled to determine the Greenwich time that corresponds to the time of observation at the place. The method of taking a lunar observation will be found in any work on navigation. The computation of lunar distances is readily effected by the aid of tables of the lunar motions, —those known as Thomson's Tables being recommended as convenient and sufficiently accurate. The time at the place of which the longitude is required is ascertained by means of a transit instrument (*see* TRANSIT INSTRUMENT), or from observations of the altitude or zenith distance of the sun or any of the planets or stars when not on the meridian, from which the hour angle must be determined. If the altitude of the sun has been taken, the hour angle gives the apparent time after 12 A.M., if the sun be to the west of the meridian, and before 12 A.M. if it be to the east; and this apparent time must be reduced to mean time by the aid of tables given in the "Nautical Almanac." When a planet or star is the object observed, the hour angle must be added to its right ascension when it is to the west of the meridian, and subtracted from it when it is to the east. This gives the sidereal time, wh[illegible] can be readily reduced to mean solar time. Greenwich time, and the time at the place of which the longitude is required, having been ascertained, the difference between the two, when reduced to degrees, minutes, and seconds, will give the longitude of the place in question, and the place will be known to be east or west of Greenwich, according as the time there is later or earlier than Greenwich time. It is manifestly impossible to do more in the present article than give a brief statement of the principles on which the determination of the latitude and longitude at any part of the earth's surface depends, and a bare enumeration of some of the methods that are used. The details of the various operations and calculations employed in practice may be gathered, as it has been already said, from any work on the science of navigation as well as from works on astronomy and geodesy.—Ref *Eng. Cyclop.*

LATITUDINARIAN, *l-t-tu-din-ai'-re-an* (Fr *latitudinaire*), among divines is applied to one who is regarded as holding loosely by denominational distinctions, and as believing that heaven is open to persons of very different denominations. M[illegible] particularly the term was applied to certain theolog[illegible] of the English church, in the latter part of the s[illegible] century. They endeavoured to allay the contests that prevailed between the more violent Episcopalians on the one hand, and the more rigid Presbyterians and Independents on the other, with respect to the forms of church government and public worship, and also between the Arm[illegible] and Calvinists, with respect to certain religious tenets. Many of them were men zealously attached t[illegible] form [illegible] government and worship of the established church, but they did not consider th[illegible] as absolutely necessary to the constitution of a Christian church, and therefore held that those who followed other forms were not to be excluded from their communion, or to forfeit the title of brethren. They reduced the fundamental doctrines of Christianity to a few points, and thus showed that the disputed subjects were matters of indifference with respect to salvation The chief leaders were Hales and Chillingworth, but Mo[illegible] Cudworth, Hale, Whitchcot, Wilkins, and Tillotson, were also among the number. They [illegible] with much opposition, and were branded as atheists and de[illegible] by some, and as Socinians by others, but upon the restoration of Charles II. they were raised to the first dignities in the church, and held in general esteem.

LATTER-DAY SAINTS. (*See* MORMONS.)

LATTICE BRIDGE. (*See* RAILWAY.)

LATUS RECTUM. (*See* ELLIPSE, HYPERBOLA, PARABOLA.)

LAUDANUM. (*See* OPIUM.)

LAUDS, *lauds* (Lat. *laus*, praise), in the monastic service, follow next after the nocturns, and consist [illegible]; psalms, hymns, &c.; whence their name. [illegible] Church of England the lauds are now merged in the matins.

LAUGHING-GAS, protoxide of nitrogen; so called from its effects upon the human system. (*See* NITROGEN, PROTOXIDE OF.)

LAUGHTER, *laf'-ter* (Ang.-Sax.), a well-known action, or emotion, peculiar to the human species. It is occasioned physically by a grateful titillation, rising suddenly and irresistibly, and manifests itself principally in the face, but extending also to the throat, thorax, and abdomen. As to the mental cause of laughter, much difference of opinion exists among philosophers. According to Aristotle, "the ridiculous implies something deformed, and consists in those smaller faults which are neither painful nor pernicious, but unbeseeming." He is sp[illegible], however, here only of the ridiculous in man[illegible] says that the seat of laughter "lies in a certain offensiveness and deformity, for those sayings are laughed at, solely or chiefly, which point out and designate something offensive in an inoffensive manner." Hobbes defines laughter to be "a sudden glory arising from a sudden conception of some eminency in ourselves by comparison with the infirmity of others or with our own formerly." Dr. Campbell controverts this opinion, and maintains that laughter "doth not result from the contempt,

but solely from the perception of oddity, with which the passion is occasionally, not necessarily, combined;' as is manifest from the following considerations:—1. that "contempt may be raised in a very high degree, both suddenly and unexpectedly, without producing the least tendency to laugh;" and, 2. that "laughter may be, and often is, produced by the perception of incongruous association, where there is no contempt." The proper object of laughter is a curious and unexpected affinity, rightly expressed by the word oddity. Kant makes the source of laughter to be a sudden conversion into nothing of a long-raised and highly-wrought expectation. In oratory, the power of exciting laughter is often of the greatest advantage, and sometimes more powerful than the strongest arguments. It is resorted to either merely to divert by that grateful titillation which it excites, or to influence the opinions and purposes of the hearers.—*Ref.* Campbell's *Philosophy of Rhetoric*; Hutcheson's *Essay on Laughter*, Beattie's *Essay on Laughter and Ludicrous Composition*, Kant's *Kritik der Urtheilskraft*.

LAUNCH, *lawntsh* (Ang.-Sax.), a wide flat-bottomed boat, strongly resembling the long-boat (which it has almost superseded); but is longer, and carries a greater number of oars, and is, therefore, better fitted for going up narrow and shallow rivers.

LAUNCHING. (*See* SHIP-BUILDING.)

LAURA, *law'-ra*, is a name given to a collection of little cells, at some distance from each other, in which the hermits of ancient times lived together in a wilderness. These hermits did not live in community, and thus differed from monks in a monastery; but each provided for himself in his distinct cell. The most celebrated lauras mentioned in history were in Palestine.

LAURACEÆ, *law-rai'-se-e* (Lat. *laurus*, a laurel), in Bot., the Laurel fam., a nat. ord. of *D[illegible]* sub-class *Monochlamydeæ*. Trees or shrubs w[illegible]-pulate leaves, usually alternate and dotted. Flowers generally perfect, sometimes imperfectly unisexual; calyx inferior, deeply 4—[illegible]-cleft, coloured in two whorls, stamens perigynous, definite; some always sterile, ovary superior, with 1 or 2 pendulous ovules. Fruit a berry or a drupe. Seeds exalbuminous; embryo with large cotyledons and a superior radicle. The order comprises 51 genera and 450 species. They are chiefly natives of tropical regions; but a few occur in North America, and one (*Laurus nobilis*) in Europe. The possession of aromatic properties, which are due to the presence of volatile oils, characterizes nearly all the plants of this order. Several have edible fruits, and many yield valuable timber. Among the useful products of this order are *cinnamon*, *cassia*, *camphor*, *sassafras*, and *bibiru bark*. (*See* LAURUS.)

LAUREATE, POET, *law'-re-ât*, is an officer of the royal household, in the lord chamberlain's department. The appellation is derived from the Latin *laurus*, a laurel, from the ancient custom of crowning the successful poets in the musical contests with a wreath of laurel. This custom prevailed among the ancient Greeks, and was also adopted by the Romans. In the 13th century it was renewed by the Italians, and the crowning of Petrarch, at Rome, was solemnized with great ceremony in 1341. The German emperors also conferred this title on their court poet. The earliest mention of a poet laureate, under that title, occurs in the reign of Edward IV., when John Kay received the appointment, though this is believed to be the same office which was held as early as the reign of Henry III., by Henry de Avranches, who is styled "king's versifier," and was paid a hundred shillings a year by way of stipend. Poet laureate, however, was also an academical title in England, conferred by the universities for proficiency in grammar, which included rhetoric and versification. The poet Skelton was thus laureated, and was among the last that received that honour. He was likewise laureate to Henry VIII. Ben Jonson was court poet to James I., but does not seem to have had the title of laureate formally granted him. The first patent of this office was granted in the reign of Charles I. (1630), and assigns to the laureate a salary of £100 a year, and a tierce of Canary wine out of the royal cellars. Dryden was appointed laureate to Charles II., and afterwards to James II. The successors of Dryden have been Nahum Tate, Nicholas Rowe, Laurence Eusden, Colley Cibber, William Whitehead, Thomas Warton, Henry James Pye, Robert Southey (who consented to a commutation of his wine for £27), William Wordsworth (with a salary of £300), and Alfred Tennyson.

LAUREL. (*See* LAURUS and CERASUS.)

LAURUS, *law'-rus*, in Bot., the typical gen. of the nat. ord. *Lauraceæ*. The species *L. nobilis* is the sweet-bay, or laurel, and probably the *Ezrach*, or green bay-tree of the Bible. It is the classic shrub that furnished the heroes of antiquity with their laurel crowns. The fruit is officinal, under the name of *bay* or *laurel berries*, and reputed to be aromatic, stimulant, and narcotic. By distillation with water, these berries yield the *volatile oil of sweet bay*. A substance called *expressed oil of bays*, or *laurel fat*, is also obtained from the fruits, both fresh a[illegible], by pressing them after they have been boiled in water. Laurel-leaves have somewhat similar [illegible] to the fruit. They are used in cookery for flavouring. They must not be confounded with the leaves of the poisonous cherry-laurel. (*See* CERASUS.)

LAVA, *la'-va* (Ital.), a general term applied to the mineral substances produced by active volcanoes. When an eruption occurs, the lava is expelled in a semi-fluid mass, about the consistence of butter; it soon cools, however, on the exterior surface, while the internal mass remains liquid for a considerable length of time. Lava consists principally of pyrocene, or augite; but various minerals enter into its composition.

LAVANDULA, *lav-an'-du-lă* (Lat.), in Bot., the Lavender, a gen. of the nat. ord. *Labiatæ*. The flowering heads of *L. vera*, the well-known lavender, yield by distillation with water *English oil of lavender*, which is largely employed in perfumery; and also in medicine, as a stimulant, stomachic, and carminative. The flowering heads of *L. spica* or *latifolia*, French lavender, yield *oil of spike*, or *foreign oil of lavender*, which has a much less agreeable odour than the English oil, and is not employed medicinally. It is used principally by painters and varnish-makers, and to adulterate the English oil. *L. Stœchas* also yields by distillation an essential oil, which is commonly distinguished as *true oil of spike*.

LAVENDER. (*See* LAVANDULA.)

LAVER. (*See* PORPHYRA.)

LAW, *law* (Lat. *lex*; from *lego*, I gather or collect), in its most general and comprehensive signification, denotes a rule of action, and is applied indiscriminately to all kinds of action, whether animate or inanimate, rational or irrational. Thus we speak of the laws of motion or of gravitation, as well as that of nature and of nations. It is, farther, a rule of action, prescribed by some superior, and which some inferior is bound to obey. In a more restricted sense, it is applied, not to rules of action in general, but of human action or conduct. Laws of human action are divided into divine and human,—the laws of God and the laws of man. The laws of God are either natural or revealed. The natural laws are such as God has implanted in the nature of man; the revealed laws, such as he has revealed to us in the sacred Scriptures. If man were to live in a state of nature, unconnected with other individuals, there would be no occasion for any other laws than those of nature and of revelation. But man was formed for society; and hence the necessity for having another class of laws for his guidance,—the human. These are of various kinds; as the law of nations, civil law, municipal law, &c.

LAW, FICTION OF. (*See* FICTION OF LAW.)

LAW MERCHANT. (*See* LEX MERCATORIA.)

LAW, MUNICIPAL, or POSITIVE, is the rule by which particular districts, communities, or nations, are governed. Municipal law, strictly speaking, denotes only the laws of a single *municipium*, or free town, yet, in common language, it is applied to the laws of a state or nation. It is defined to be "a rule of civil conduct, prescribed by the supreme power in a state." The sovereign power is the power of making laws, which is sometimes vested in an aggregate assembly, consisting of all the free members of a community, when it is called a democracy; sometimes in a council composed of select members, when it is styled an aristocracy; and sometimes it is in the hands of a single individual, when it is termed a monarchy. All

other species of government are either corruptions of, or reducible to, these three. It is in the power of the legislature at any time to alter the law. The proper function of the executive is to administer the law, not to make it; to act upon its true construction, not to fix it. The legislative power of a government is generally employed in mere acts of amendment and supplement. Its office is not so much to create systems of laws as to supply defects and cure mischiefs in systems already existing. Frequent experiments have shown that laws at variance with the manners and religious views of a people cannot be forced upon them, however well meant and however beneficial may have been their influence upon other people; and that by means of laws a legislator can no more elevate his countrymen to a higher degree of refinement, without passing through the intervening steps, than he can reduce them again to a condition above which they have risen in the natural course of events. The legislation of no country probably ever gave origin to its whole body of laws. In the very formation of society, the principles of natural justice and the obligations of good faith must have been recognized before any common legislature was acknowledged. Wherever we trace positive laws in the early stages of society, they are few, and not of any wide extent. The formation of codes or systems of general law for the government of a people, and adapted to their wants, is a business which takes place only in advanced stages of society. The Institutes, Pandects, and Code of Justinian were made in the latter ages of Roman grandeur, not by instituting a new system, but by embodying the maxims, the rules, and the principles which the ablest jurists had collected in different ages, and from the various lights of reason, experience, and juridical decision. Laws may be divided into declaratory, directory, remedial, and prohibitory or penal. Declaratory laws are such as declare what the law is or shall be. Directory laws are such as prescribe rules of conduct, or limit or enlarge rights, or point out modes of remedy. Remedial laws are those whose object is to redress some private injury or some public inconvenience. Prohibitory and penal laws are those which forbid certain things to be done or omitted, under a penalty or vindicatory sanction. Municipal law is also divided into written and unwritten, or statute and common law. Statute law is the express written will of the legislature, rendered authentic by certain prescribed forms and solemnities. The common law includes those principles, usages, and rules action applicable to the government and security of person and property, which do not rest for their authority upon any express and positive declaration of the will of the legislature, but which have come into use by gradual adoption, and received from time to time the sanction of the courts of justice, without any legislative act or interference. According to Sir Matthew Hale, the common law of England is "not the product of the wisdom of some one man, or society of men, in any one age; but of the wisdom, counsel, experience, and observation of many ages of wise and observing men." The best evidence of the common law is to be found in the decisions of the courts of justice, and in the treatises and digests of learned men. This distinction between written and unwritten law is of great antiquity, having been in use among the ancient Greeks and Romans, though it does not seem to have been regularly made by the jurists.

LAW OF ENGLAND, THE, is divided into written or statute law, and unwritten or common law. The former of these comprises the statutes, acts, or edicts made by the sovereign, by and with the consent of the lords spiritual and temporal, and the commons in parliament assembled. It is a principle in the English law, that an act of parliament, delivered in clear and intelligible terms, cannot be questioned, or its authority controlled in any court of justice. A statute begins to operate from the time that it receives the royal assent, unless some other time be fixed by the act itself for the purpose. In interpreting statutes, the courts are governed by former adjudications, or, in the absence of these, by analogy and general reasoning. The words of a statute are to be taken in their natural, plain, obvious, and ordinary signification and import. It is to be construed, not according to the mere letter, but the intent and object for which it was made. Remedial statutes are to be construed liberally, and penal more strictly. Statutes are either public or private. A public statute is a universal rule that regards the whole community; private acts are such as concern the particular interest or benefit of certain individuals, or of particular classes of men. Generally speaking, statutes are public, and a private statute may be regarded as an exception to the general rule. Of private acts, some are local, as affecting only particular places; others personal, as confined to particular persons. Formerly the courts of law were not bound to notice judicially private statutes; so that it was necessary, in order to plead one of these, to set it forth particularly; but now, by 13 & 14 Vict. c. 21, every act is to be taken as a public one, and judicially noticed as such, unless the contrary be expressly declared. For convenience of reference, acts are now also divided, in our printed statute-books, into public general acts, local and personal acts declared public, private printed acts, and private acts not printed. The common, or unwritten law (*lex non scripta*), is so called, not as being, strictly speaking, unwritten, but because its original institution and authority are not set down in writing. It is what has been called by Mr. Bentham "judge-made law," the monuments and evidences of which are contained in the records of the several courts of justice, in books of reports and judicial decisions, and in the treatises of learned jurists preserved and handed down to us from the earliest times. It includes, not only general customs, or the common law properly so called, but also the particular customs of certain parts of the kingdom, as well as those particular laws that are, by custom, only observed in certain courts and jurisdictions. The unwritten, or common law, is thus distinguishable into three kinds:—1. General customs, which are the universal rule of the whole kingdom, and form the common law in its stricter and more usual signification. 2. Particular customs, which affect only the inhabitants of particular districts. 3. Certain particular laws which, by custom, are adopted and used by some particular courts of pretty general and extensive jurisdiction. General customs, or common law strictly so called, "is that law by which proceedings and determinations in the ordinary courts of justice are principally guided and directed; this, for the most part, settles the course in which lands descend by inheritance; the manner and form of acquiring and transferring property; the solemnities and obligations of contracts; the rules of expounding wills, deeds, and acts of parliament; the respective remedies of civil injuries; and an infinite number of minuter particulars, which diffuse themselves as extensively as the ordinary distribution of common justice requires." Judicial decisions are the principal and most authoritative evidence that can be given of a general custom. When questions occur which do not happen to be fixed by any known decision, these are disposed of by the judges in the manner that they think most conformable to the received rule in analogous cases; or, if there be none such to guide them, then according to the natural reason of the thing. The judges are the depositaries of the laws,—the living oracles who must decide in all cases of doubt, and who are bound by oath to decide according to the law of the land. The second branch of the unwritten laws of England are particular customs or laws which affect only the inhabitants of particular districts, and which are commonly distinguished by the word "customs" *per se*. A custom, therefore, so far as it extends, supersedes the general law. Such is the custom of gavelkind in Kent, which ordains that not the eldest son only, but all the sons alike, shall succeed to the father's inheritance; and the custom of borough-English, which prevails in certain boroughs, that the youngest son shall inherit the estate in preference to all his elder brothers. Such, also, are the special and particular customs of manors, of which every one has more or less, and which bind all the copyhold and customary tenants who hold of the said manors. A custom, in order to be legal and binding, "must have been used so long that the memory of man runneth not to the contrary." Now, legal memory dates from the first year of Richard I.; so that if a custom can be shown to have commenced since that date, it is void

as a custom. It is not necessary, however, to prove its existence for so long a time, the presumption being, in want of evidence to the contrary, that it has prevailed during the whole of that period. Farther, by 2 & 3 Will. IV. c. 71, it is declared that customary and prescriptive claims of rights to be exercised over the lands of other persons (as the rights of common way, or the like) shall be sufficiently established by an uninterrupted enjoyment, in some cases for thirty, in others for twenty years. A custom must have been continued, because any interruption would give rise to a new beginning, which would be within time of memory, and thus invalid. It must have been peaceable and acquiesced in,—not subject to contention and dispute; for a custom derives it[illegible] force and authority from common consent; but wh[illegible], this consent is wanting. It must also be reasonable; or rather, it must not be unreasonable. Farther, customs ought to be certain, and must be consistent with each other. It is also a rule, that customs in derogation of the common law must be construed strictly; and no custom can prevail against an express act of parliament. Besides local customs, properly so called, there are, in different parts of the country, certain *usages* existing, which, unless excluded expressly or impliedly, by agreement between the p[illegible], regulate to some extent the relation of landlord and tenant, or affect the reciprocal rights of incoming and outgoing tenants, and are usually known as "customs of the country" Similar to these are the "usages of trade" which exist in certain places, and, in order to be effective, must be proved by apt evidence. The third branch of unwritten, or common law, comprises those laws which are in use only in certain particular courts and jurisdictions. These are the civil and canon laws. The reason why these are classed under unwritten law is that, though contained in codes, institutions, decretals, &c., they have their force and efficacy in this country, not on that account, but because they have been admitted and received by immemorial usage and custom in some particular cases and in some particular courts. By civil law, absolutely taken, is generally understood the civil or municipal law of the Roman empire, as comprised in the Institutes, Code, and Digests of the emperor Justinian, and the Novel C[illegible]stitutions of himself and some of his successors. (*See* CIVIL LAW, JUSTINIAN'S CODE.) The canon law is a body of Roman ecclesiastical law relative to such matters as that church either had, or pretended to have, the proper jurisdiction over. (*See* CANON LAW, DECRETALS.) There is another branch of unwritten law to which no reference has yet been made, but which has long formed part of [illegible]tutes one of its princip[illegible], which is distinct from common law, strictly so called. (*See* EQUITY.) The division adopted by H. Stephen in his "Commentaries on the Laws of England," differs, in some respects, from that of Blackstone. The first great division of all municipal law is into rights and wrongs; the liberties and advantages secured to subjects on the one hand, and th[illegible]ng done by violations of them on the other. Rights he divides into—1. Personal rights, or such as regard a man's own person; 2. rights of property, such as regard his dominion over the external and sensible things by which he is surrounded, being (*a*) as to things real, (*b*) as to things personal; 3. rights in private relations, as (*a*) between master and servant, (*b*) husband and wife, (*c*) parent and child, (*d*) guardian and ward; 4. public rights, as regards one's social condition as a member of the community, being (*a*) as to the civil government, (*b*) as to the church, (*c*) as to the social economy of the realm. Under each of the divisions of rights are included the converse or reciprocal [illegible] duties. Wrongs are divided [illegible] injuries and crimes; the former when the injury do[illegible]s to a particular individual, the latter when to the public at large. The object of a civil action is the redress of the plaintiff by conferring on him the right or compensation for the violation of a right which he claims from the defendant. The object of a criminal prosecution is to inflict punishment on the defendant for the breach of a legal duty which is imputed to him. Criminal law is not identical with penal law, for an act or omission may be liable to legal punishment in consequence of an action instituted by a private person. *Criminal Law.*—A crime or misdemeanour is an act committed or omitted, in violation of a public law either forbidding or commanding it. Crime and misdemeanour are, strictly speaking, synonymous terms, though in common usage the former is applied to greater offences, the latter to such as are of less consequence. All crimes ought to be estimated merely according to the mischief which they produce in civil society; for human laws ought only to concern themselves with social and relative duties, being intended only to regulate the conduct of man, considered under various relations as a member of civil society. Hence, private vices, or breaches of mere absolute duties, which man is bound to perform considered only as an individual, cannot be the proper object of any municipal law, any farther than their evil example or other pernicious effects may be prejudicial to the community. There are, however, some misdemeanours which are punished by the municipal law, that have in themselves nothing criminal, but are made unlawful by the positive constitutions of the state, for public convenience; as poaching, &c. The offences which are either directly, or by consequence, injurious to civil society, and therefore punishable by the laws of England, are divided into the following gen[illegible]:—1. those which are more immediately injurious to God and his holy religion; 2. such as violate and transgress the law of nations; 3. such as more especially affect the sovereign executive power of the state, or the king and his government; 4. such as more directly infringe the rights of the public or commonwealth; and 5. such as derogate from those rights and duties which are owing to particular persons, and in the preservation and vindication of which the community is deeply interested. The several species of offences against God and religion are apostasy, heresy, offences against the established church, blasphemy, swearing and cursing, witchcraft and conjuration, religious imposters, simony, profanation of the Lord's day, drunkenness, lewdness The principal offences against the law of nations, regarded as such by the municipal laws of England, are of four kinds:—1. Violation of [illegible]; 2. infringement of the rights of ambassadors; 3. piracy; 4. offences connected with the slave-trade. The crimes more especially affecting the supreme executive power are treason, felonies injurious to the king's prerogative, præmunire, and misprisions, and contempts affecting the king and his government. Of crimes aff[illegible] the commonwealth are—1 Offences against [illegible], as falsifying records, perjury, bribery, a[illegible], 2. offences against the public peace; 3. offences against public trade; 4. offences against the public health; and 5. offences against the public police and economy. Of those crimes which in a more particular manner affect and injure private individuals, there are three classes,—against their persons, their habitations, and their property. Of crimes [illegible] the persons of private individuals, are [illegible] of justifiable, excusable, and felonious; mayhem, or the violent depriving another of the use of such of his members as may render him the less able in fighting, either to defend himself or annoy his adversary; the forcible abduction of an heiress; rape; sodomy, &c.; concealing birth, assaults, batteries, wounding, false imprisonment, kidnapping The offences against the habitations of individuals are arson and burglary. Against private property the offences are larceny, simple and compound; malicious mischief, and forgery. (These offences will be found more particularly noticed under their several names, in other parts of this work.) Crimes are farther, as regards the mode of proceeding peculiar to each, divisible into two great classes,—1. such as are punishable on indictment or information (the common-law methods of proceeding); and 2. such as are punishable on summary conviction before a justice or justices of the peace, or other authorized persons, without the intervention of a jury, as directed by various acts of parliament. Indictable offences are distributed into four classes; namely, treasons, præmunires, felonies, misdemeanours. Offences punishable on summary conviction are principally such as are against the laws of the excise, or other branches of the revenue; disorderly offences and petty assaults; petty thefts, not amounting to larceny; injuries to property, &c.

Law of Exception (Fr. *loi d'exception*), in political affairs, is applied to those extraordinary measures that are sometimes necessary to be adopted when the situation of a state is so critical that the ordinary powers and laws are no longer considered sufficient. These extraordinary measures are various. Among the ancient Romans, for such an emergency the two consuls were invested with greatly augmented power, and if that was not sufficient, a dictator was appointed. In England, the first and most important measure in such a case is the suspension for a limited time of the *Habeas Corpus* act. The government can then take into custody suspected or dangerous persons, without following the regular course of law. (*See* Habeas Corpus Act.) Another regulation of this kind is the alien bill, which invests the government with a power over all foreigners dwelling in England, such as does not constitutionally belong to it, giving the right not only to order them out of the country at pleasure, but also to send them to any part of the continent. Bills of pains and penalties, which are admissible in single cases, constitute also a sort of law of exception. Parliament maintains the right to pass such bills, which could not belong to it under a correct division of

it must be sanctioned by both houses of parliament and receive the assent of the king.

Law of Nations, or International Law, is defined "as consisting of those rules of conduct which reason deduces as consonant to justice from the nature of society existing among independent nations, with such modifications and deviations as may be established by general consent." It depends entirely upon the rules of natural law, or upon mutual compacts, treaties, or leagues between communities, in the construction of which compacts, also, there is no other rule to resort to than the law of nature. International law is a science of modern origin. Among the Romans the *jus gentium* generally signified what is commonly called natural law; viz., the principles of right which are dictated by reason, and are common to all men. The *jus fetiale*, which regulated the ceremonies attending a declaration of war, or the mode of arranging terms of peace, &c., was of this nature, but under the emperors it fell into disuse. The first systematic treatise upon the practice of nations in the conduct of war was the "De Jure et Officiis Bellicis" of Balthasar Ayala, which appeared in 1581. In 1625 appeared at Paris the celebrated treatise "De Jure Belli et Pacis," by Hugo Grotius, who, according to Sir James Mackintosh, "was, without dispute, the first to give a new form to the law of nations, or rather to create a science, of which only rude sketches and undigested materials were scattered over the writings of those that had gone before him." This treatise is not limited to the law of war and of peace, but embraces, also, a view of the general principles which should govern the intercourse of nations. The sources of international law are, according to Grotius, natural law, divine law, customs, and compacts. The law of nations may, therefore, be divided into two great classes or principles; viz., those which arise from natural or universal law and those which are of mere human institution,—the former being the universal, the latter the positive law of nations. The latter is again divisible into the customary law, or that which arises from the silent consent of nations, as evidenced by general usages and customs and habits of intercourse, and the conventional law, which arises from express compacts or treaties between nations. Another division of international law is into the public and private law of nations,—the former regulating the rights, intercourse, and obligations of nations, as such, with each other, the latter regulating the rights and obligations more particularly belonging to their respective subjects; as the rights of the subjects of one state to property situated within the territory of another. States, then, are the proper and immediate subjects of this national law. To every state are ascribed the attributes of sovereignty,—independence, and equality with every other. Every nation which governs itself independently of any other nation is deemed a sovereign state. In respect to each other, nations possessed of sovereignty are deemed equals, and are entitled to the same general rights and privileges, whatever may be their relative strength or weakness. Every sovereign state may adopt whatever form of government and whatever political institutions it may prefer, free from the control of any foreign power. It may also form alliances, provide land and sea forces, build fortifications, or employ any other usual means for its defence. It is possessed of exclusive jurisdiction within its own territory over all persons and things therein. It possesses the power, in virtue of its sovereignty, to punish all crimes committed against it, and to enforce all civil obligations due to it from persons subjected to its authority. Among the duties incumbent upon a state are to provide for the safety, peace, and happiness of its own subjects; to redress wrongs; to promote industry and commerce. The basis on which all the rights and duties of nations in their intercourse with each other rests, is the fundamental maxims that they are all moral persons, and that each has a perfect equality in sovereignty and social rights with every other. They are regarded as moral persons possessed of a sense of right and wrong, and responsible to God for a proper discharge of their duties. They are thus bound not only to do justice but to perform the offices of humanity and to render mutual assistance to each other, upon the same principles that individuals are bound to the like duties. Hence it is the duty of every state to cherish, as far as may be, an honest and frank intercourse with all others upon principles of reciprocal benevolence, to abstain from doing injury and wrong to others, and to succour and assist such as may be suffering from famine, pestilence, or other calamity. The rights and duties of nations towards each other may be divided into those which belong to a state of peace and those which belong to a state of war. Among the rights which belong to a state of peace, is that of the exclusive power of every state within its own domain; and consequently no nation can rightfully exercise any jurisdiction or sovereignty within the territories of another, either over persons or things, for, in respect to foreign nations, not only public domain, but all the private property of the subjects of a nation situated within its limits, is deemed the property of the nation. The state's exclusive jurisdiction extends, of course, ver all rivers and lakes which are entirely within its wn territory. Where a river forms the limit of conerminous states, the presumption is that both have he right of navigation of the whole river, though, acording to the Roman law, the middle line of the river orms the strict limit between the two. By the general law of nations, a state's right over the waters vhich wash its coasts extends to a marine league, or he distance measured by a cannon-shot from the shore t low water. The open ocean is the common territory f all nations. Though a sovereign state concedes no roper force to foreign laws, yet, upon the principle of eciprocity, complete or partial, or upon consideraions of equity or international comity, they may be ecognized and allowed their effect. But in no case ill a state admit the operation of other laws than its wn when that would prejudice the rights or interests of its citizens or in any degree infringe its own sovereign authority. The jurisdiction of a state also extends so far as to exempt its sovereign, or his ambassador, or his fleets and armies, from the operation of the laws of a country where they may be. Special conventions may also concede to consuls an authority over their countrymen residing in a foreign state. In civilized countries this authority is usually limited to such civil matters as arise out of disputes between shipmasters and seamen, and to the acts of attesting contracts and protests, and authenticating other mercantile instruments. In criminal affairs, the consul's jurisdiction is limited to the infliction of fines, and in grave cases it is his duty to collect evidence and send the accused to his own country for trial. In barbarous states, consuls often possess complete and exclusive jurisdiction over all matters in which their countrymen are interested. The judicial power of a state reaches all offences committed against its laws, whether by its own subjects or by aliens. If an offender against the laws of one state has escaped within the jurisdiction of another, the former may demand the surrender of the criminal. Murder, rape, arson, perjury, embezzlement by public officers, and the fabrication and circulation

of counterfeit money, are usually enumerated as causes of extradition. In most of the European states, fraudulent bankruptcy is also included. Neither England nor the United States of America admit of the extension of this law to political refugees. Every nation has a right to regulate its own commerce and intercourse with other nations in such a manner as is most conducive to its own prosperity and interests, without depriving others of their just rights. The property held by foreigners within a country according to the laws ought to be protected in the same manner as that of natives. It is a general rule among nations, to regulate the descent, distribution, and alienation of immovable property exclusively by the laws of the country wherein it lies. As to movable property, it is now a common custom, and seems most reasonable and just, to allow foreigners the liberty of disposing of it, by will or otherwise, according to the laws of their own country or of their permanent domicile. In order that the intercourse between nations may be beneficially carried on, public functionaries are necessary to represent a state at foreign courts, to promote its interests and adjust disputes. Hence the right of every nation to send and receive ambassadors and other public ministers. The privilege of continuous residence, however, rests in comity, and is not matter of right. The law regarding ambassadors occupies an important place in the law of nations. (*See* AMBASSADOR.) Treaties and compacts are not generally deemed final till they have received the sanction of their respective governments. Treaties are to be understood and construed according to their obvious meaning and the intention of the contracting parties. Treaties may be dissolved in various ways; as, 1. by the voluntary assent of the parties, or by their express limitation; 2. by a formal dissolution pronounced by one of the parties, acting upon its own responsibility, in the exercise of sovereign authority; 3. by operation of law, as in cases where the contracting parties lose their distinct sovereignty; 4. by implication, as where new treaties are formed between the parties upon the same subject, or where circumstances so change as to make the treaty utterly foreign to the existing state of things. Sovereign states being equal, it follows that there can be no supreme tribunal of appeal. Except, therefore, by submission of their wrongs to arbitration, nations can have no redress for them except by resorting to force. When these differences have arisen, and they cannot be composed by negotiation or other peaceful means, the injured state may employ the forcible measures of retaliation, reprisals, embargo, or the sequestration of the goods of the offending party, or finally, of war. Embargoes or sequestrations are often declared, as preliminary measures to active hostilities. A declaration of war has a retroactive effect, and the property already seized is placed upon the same footing as that taken during the war. Reprisals are general or special. They are general when a state authorizes its subjects to capture the goods and attack the subjects of the offending power wherever they may be found. In modern practice, general reprisals are deemed synonymous with war, and are, indeed, the initiative step to hostilities. When wrong is done to particular individuals in time of peace, and justice is refused, or unreasonably withheld, letters of marque may be issued to the parties, or a public ship commissioned to avenge their wrongs. These are instances of special reprisals. The debt having been satisfied, or the injury compensated for, the surplus must be restored to the government of the subject against whom the right has been exercised. As to the mode of declaring war, it may be formal, as by public declaration, or informal, as by actual hostilities. In modern times, nations are accustomed generally to make a public declaration, and to justify themselves before the world by a manifesto of their reasons. A declaration of war puts the subjects of each of the states in a state of hostility to each other, and all public and private social intercourse are suspended between them. They are not at liberty to engage in trade or commerce, or contract with each other; yet, for good reasons, either power may, by express license, permit a partial intercourse. Forthwith all the enemy's property is, by the law of war, subject to confiscation; thus debts due from one state to the other may be sequestered, or property lying within the territory of the one may be seized by the other as prize of war. But, in the exercise of international comity, these rights are not usually enforced. The obligation of debt is, as it were, suspended during the war, but the right of recovery revives with the peace. The wanton destruction of the enemy's property, or the lives of his subjects, is, in the modern practice of nations, unjustifiable and illegal; and generally all those who are engaged in the merely civil duties of life are exempted from the direct effects of war. Property at sea, however, makes an exception to the usual indulgence shown to the goods of an enemy, and ships and their cargoes upon the ocean are liable, without exception, to seizure and confiscation. In general, each nation restrains the right to make captures and to carry on hostilities to such persons as are in the public employment, or to such as receive a public commission for that purpose. Mere private warfare is seldom allowed. Thus, the usual modes of carrying on war are by armies, navies, and privateers, acting under the immediate authority of the government. Privateering, though admitted by the present of nations to be a legitimate mode of carrying on war, is held by some states to be contrary to correct and liberal notions of modern warfare. The validity of all claims of prize and capture is determined by the prize courts of the captor's country. These exercise jurisdiction over captured property lying either in their own ports or in those of an ally or neutral. They adjudicate on all captures made by subjects of their sovereign exclusive of the tribunals of all other nations, excepting only in cases where the capture was made upon the territory of a neutral, or by vessels fitted out within a neutral's limits. These cases involve an invasion of the neutral's sovereignty, and must be adjudicated in his court. The decisions of the prize courts are final and conclusive upon the rights of property involved; and if their judgments work injustice to the subjects of other powers, their claims must be adjusted between the sovereigns of their respective states. The belligerent powers may enter into general or special conventions, either for the general conduct of the war or for lightening its rigours. The former are often made at the beginning of a war, and may regard the abstaining from certain modes of warfare, the exchange or redemption of prisoners, passports, safe-conducts, and such-like. Particular conventions are made during war, and concern either truces or partial suspensions of hostilities, or capitulations, that is, surrenders of particular forces or places. The power of concluding a truce is generally implied in the character of every high officer, as a general or admiral. While a truce lasts, all warlike acts and preparations must entirely cease, though it does not hinder acts which are allowable in time of peace. Though no state is bound to take part in the wars in which other states may be engaged, yet no independent state can retain the same complete independence which it enjoys in a time of general peace. Belligerents have a right to insist that neutrals shall conduct themselves with good faith towards both parties, and abstain from all interference in the contest. In matters which do not directly concern the war, a neutral must not refuse to one belligerent what it grants to the other. General trade with belligerents is not interdicted by war; but a neutral must not send his ships to blockaded ports, for that would be interfering directly with the measures of the belligerents. But, to subject a neutral to its operation, the blockade must exist in point of fact; there must be a squadron present, and strong enough to constitute an actual blockade of the port. A neutral must not carry goods contraband of war, as arms, ammunition, or the like; nor bear despatches, nor transport troops to either party, unless, indeed, it be bound to do so by previous stipulations. Contraband property is subject to confiscation by the captor. By declaration, signed at Paris, by the representatives of the chief European powers, in 1856, the principle that neutral ships may carry enemy's goods has been established. The same declaration sanctions the rule that neutral property, except contraband, is not subject to capture though laden in an enemy's ships. The persons and property of enemies within the jurisdiction of a neutral are deemed inviolable, and entitled to

neutral protection. The right of search exercised by belligerents over the vessels of neutrals for articles contraband of war is strictly confined to merchant ships, and is never extended to ships of war belonging to the state. In the case of a civil war, neutrals are bound to abstain from all active interference, either on the one side or the other; but if it gives rise to the formation of a new government, it is not an act of hostility to recognize it as an independent state, though to do so would be regarded as such, so long as the contest was dubious. When the objects of war are accomplished, peace has to be concluded. Generally a formal treaty of peace is entered into between the two parties, which takes effect from the day on which it is ratified. The treaty puts an end to the war, and puts at rest for ever the debated matters which were the cause of it; conquered lands and fortresses remain with the conqueror, unless otherwise stipulated. The violation of one article is a breaking of the whole treaty, and ends the peace.—*Ref.* Vattel's *Law of Nations;* Wheaton's *Elements of International Law;* Mackintosh's *Discourse on the Study of the Law of Nature and of Nations;* Kent's *Commentaries on American Law.*

Lawn, *lawn* (Fr. *linon*), a fine variety of cambric, formerly made exclusively in France and Flanders. The lawn of Scotland and the north of Ireland has recently come to almost equal the production of the Flemish manufacture.

Lawn, in Gard., signifies a piece of turf or grass, kept smoothly mown, in front of gentlemen's mansions or in pleasure-grounds.

Lawsonia, *law-so'-ne-a*, in Bot., a gen. of the nat. ord. *Lythraceæ*. *L. inermis* is the plant from which the *henna* or *alkanna* of Egypt, &c., is derived. It is used by the women of the East to dye the nails, palms of the hands, and soles of the feet an orange-brown colour. It is likewise employed for dyeing skins and morocco leather.

Lay Baptism, *lai* (Fr. *lai*, from Gr. *laos*, people), is baptism administered by lay or unordained persons. It was practised and regarded as valid by the laws of the early Church; but it was looked upon as an exceptional proceeding, and only to be resorted to in cases of emergency.

Lay Brothers, among the Roman Catholics, pious but illiterate persons, who, in convents, devote themselves to the service of the monks. The institution of lay brothers began in the 11th century. They wear a different habit from the monks, and never enter the choir nor are present at the chapters. The only vow they take is of obedience and constancy. There are also lay sisters in the nunneries, who are retained for the service of the nuns.

Lay Chancellor is an officer found in the Church at an early period. Bishops being often appealed to in civil causes, at length found it necessary to devolve some part of this service upon others; and hence the institution of lay chancellor.

Lay Elders were a class of office-bearers in the early Church, but were not of the clergy, nor had they any concern in the discipline or government of the Church; and hence they differed from the modern ruling elders. The office of ruling elder, as existing in the Presbyterian church, was unknown before the 16th century. The passage, 1 Tim. v. 17, where the office of ruling elders is referred to, evidently denotes ordained ministers. The lay elders of the early Church were intrusted with the utensils, treasure, and outward affairs of the church.

Lazaretto, or **Lazar-house**, *laz'-zar-et'-to* (Ital.), is the name given in Italy, and other parts of southern Europe, to certain public buildings for the reception of the poor, and such as are afflicted with contagious disorders. The name is derived from St. Lazarus, who is the patron saint of lepers; and during the middle ages, when leprosy was common in Italy and other parts, the hospitals in which the lepers were confined received that name, and the lepers themselves were called lazzari. Howard wrote "An Account of the principal Lazarettos in Europe," 1789. Those buildings and inclosures attaching to seaport towns, chiefly on the Mediterranean, where the crews and passengers of ships from places where contagious disease is known to prevail, are also called lazarettos. These lazarettos consist generally of various detached buildings, with courts between, the whole being surrounded by a wall, and placed in an airy situation outside the town, or sometimes on a small island near the coast. (*See* Quarantine.)

Lazarists, *laz'-a-rists*, in Eccles. Hist., is the name of a religious order of missionaries, founded by St. Vincent de Paul, at Paris, in 1632, and named from the priory of St. Lazarus there, where they had their head-quarters. Besides their religious and educational duties, they specially devoted themselves to the care of the sick. In Poland this order has been particularly active, and its members are there known as the Mission Fathers.

Lazulite, *laz'-u-lite*, a light blue mineral, resembling lapis lazuli only in colour. It is a hydrous combination of the phosphates of alumina, magnesia, lime, and iron. It is also known as *azurite* and *prismatic azure spar.*

Lazzaroni, *lat'-zar-ro'-ne*, is the name given to the lowest class of inhabitants in Naples, from the hospital of St. Lazarus, which served as a refuge for the destitute in that city. They constitute a particular class of themselves, living mostly, day and night, the whole year through, on the streets, and earning a precarious livelihood as messengers, porters, day-labourers, &c. They elect, annually, one of their own body as chief, who has the title of *Capo Lazzaro*, and is formally recognized by the government, for the reason that through him they are best able to control this great mass of people, numbering from 50,000 to 60,000.

Lead, *led* (Sax. *lead*), one of the most important of the metals, both itself and its compounds being applied to many useful purposes. It occurs in nature in combination with a large number of substances; but its most valuable ore is galena, or sulphide of lead, found in large quantities in various parts of the world. In this country it is found mixed with quartz blende, iron pyrites, heavy spar, and fluor spar, in veins running through the primitive rocks of Cornwall and Cumberland. It generally contains a small proportion of sulphide of silver, often in sufficient quantity to allow of its being separated profitably. The ore having been brought to the surface, is first sorted by hand, the purest portions being set aside ready for smelting. The rest is broken by hammers into lumps as large as a walnut, and again sorted. The remainder is then crushed in a mill, and sifted through coarse sieves, the coarser portions being set aside for the stampers, and the finer being subjected to the process of *jigging*. This consists in plunging a sieve containing the ore into water, and shaking it dexterously, so that the smallest particles pass through, leaving the larger pieces in the sieve, with the lightest and least metallic portions uppermost. If the sorted galena be tolerably free from gangue, about $1\frac{1}{2}$ ton of the ore is mixed with $\frac{1}{30}$ to $\frac{1}{50}$ its weight of lime, and heated to dull redness in a reverberatory furnace, through which a current of air is passing. By this means a large portion of the sulphur is burnt off as sulphurous acid, oxide of lead and sulphate of lead being formed, and much of the ore remaining undecomposed. When the roasting has been carried sufficiently far, the furnace doors are shut and the heat is raised. The sulphate and oxide of lead react on the undecomposed sulphide, a large quantity of sulphurous acid is formed, which passes off, leaving large quantities of metallic lead behind. The fire is now damped, and a quantity of lime thrown in, which forms a very infusible slag, allowing the metallic lead to be drawn off into moulds. The slag, which contains a large proportion of lead, is smelted with an additional portion of ore. Lead is refined by being melted in a shallow iron pan in a reverberatory furnace. By this operation any tin or antimony that it may contain is oxidized and removed as skimmings. When a ladleful of the lead under this operation cools with a peculiar crystalline surface, the process is discontinued, and the metal is run off into pigs. For some purposes, such, for instance, as the making of red lead for the manufacture of flint glass, it is necessary that the lead should be almost chemically pure, as a proportion of copper, for instance, amounting only to a few grains per ton, would colour the glass and spoil the batch. Silver may be profitably extracted from lead, even when it contains only three or four

ounces to the ton, by Pattinson's process. This process depends upon the fact, that as lead solidifies, the first portions that crystallize are pure lead. The operation is therefore performed by melting the metal in an iron pot and allowing it to cool gradually; as it cools, the crystals of pure lead are removed by a perforated ladle, and the process continually repeated with fresh portions of lead until the mass contains about 300 oz. to the ton. It is then submitted to cupellation, which is fully described under that head. In 1861, no less than 500,000 oz. of silver were extracted in this way from argentiferous lead. Lead is a bluish-white metal, so soft that it may be marked with the nail. It may be beaten into pretty thin sheets, as well as drawn into wire; but its malleability and tenacity are both low. It fuses at 630°, and may be obtained in cubic or octahedral crystals as it cools. It does not cast well, owing to its contracting at the moment of solidifying. The uses of lead are very numerous,—its softness, fusibility, and durability rendering it valuable for a variety of purposes. It is used by the manufacturing chemist for the chambers of his sulphuric acid and hydrofluoric acid apparatus. Its compounds are well known. The red oxide is employed extensively in making glass; the carbonates, oxychlorides, and chromates, are used as pigments; and its alloys are numerous and important. Its alloys with tin are harder, but more fusible, than their component metals, the most fusible containing 3 equivalents of tin and 1 of lead, which fuses at 367° Fahr. *Pewter* consists of lead with 80 or 90 per cent. of tin. The alloy used for lining tea-chests contains 9 of lead and 1 of tin. *Type-metal* is composed of 4 parts of lead and 1 of antimony. *Plumbers' solder* contains equal parts of tin and lead. *Shot* are made of an alloy of lead, and from 0·3 to 0·8 per cent. of arsenic, to give the shot a spherical form. The fused metal is poured through a sieve from a height, the shot cooling as they descend. If too little arsenic is added, they assume a pyriform shape, lenticular masses being the result if the proper proportion is exceeded. The shot are afterwards sorted and polished by rolling them about in a barrel containing plumbago. The lead of commerce is nearly pure, the purest specimens being the softest. To obtain it chemically pure, it should be reduced by black flux from the oxide left by igniting pure acetate of lead, or by reducing sulphate of lead by charcoal. The annual produce of our English lead-mines exceeds 90,000 tons, being equal to 65,000 tons of metal.

Lead, in Chem.,—symbol Pb (plumbum), equiv. 103·57, spec. grav. 11·44.—The method of [illegible] chemically pure lead has been described [illegible]. Chemically speaking, lead occupies a position [illegible] silver and mercury, being closely allied to these two metals in many of its re-actions. The salts of lead are mostly colourless. They are all highly poisonous, the best antidote being sulphate of soda, or magnesia, which forms a [illegible] inert and insoluble sulphate. In the [illegible] of lead-poisoning, when, for instance, the metal becomes introduced into water from the incautious use of lead pipes, these antidotes are ineffectual. The best tests for the presence of lead are the formation of an insoluble white precipitate, when sulphuric acid, or sulphates, are added to the suspected solution. This test should be confirmed by forming a black sulphide with sulphuretted hydrogen, a yellow chromate with chromate of potash, and a yellow iodide with iodide of potassium. Lead has a comparatively weak affinity for oxygen; it consequently remains almost unoxidized even in damp air. It is easily precipitated in a metallic form from its solutions by other metals. Under the combined action of air and pure water, lead is liable to corrosion; great care should therefore be exercised in using lead pipes in districts supplied with pure water.

Lead, Acetates of, in Chem.—Acetic acid forms at least four compounds with lead; viz., the

Neutral acetate	$PbO, C_4H_3O_3+3Aq.$
Subsesquiacetate	$3PbO, 2C_4H_3O_3, Aq.$
Tribasic acetate	$3PbO, C_4H_3O_3\ Aq.$
Hexacetate	$6PbO, C_4H_3O_3\ Aq.$

The most important of these are the neutral acetate and the tribasic acetate. The former is made by dissolving litharge in excess of acetic acid and evaporating. With care it may be made to crystallize in fine right rhombic prisms; but its most usual form is a mass of confused crystals resembling loaf-sugar; from which circumstance, joined to its sweetish metallic taste, it has received the name of sugar of lead. It dissolves readily in water and alcohol. Exposed to the air it effloresces, and heated, it becomes anhydrous, and fuses into a clear liquid. Heated further, it gives off carbonic acid, acetone being formed. In this form it consists of the *subsesquiacetate of lead*, a salt having a distinct alkaline reaction, and crystallizing in pearly scales. *Triacetate of lead*, which forms the basis of *Goulard water*, is prepared by digesting 7 parts of finely-powdered litharge with 6 parts of the neutral acetate dissolved in 30 parts of water. It has a strong alkaline reaction, and crystallizes in opaque needles.

Lead, Black, in Min.—The substance known by this name contains no lead, nor any metallic substance, being simply carbon in a peculiar state of aggregation. (*See* Graphite and Plumbago.)

Lead, Borate of, in Chem.—Boracic acid unites mechanically, when fused with oxide of lead, in all proportions. But little is known of the chemical borate of lead. It enters into the composition of Faraday's optical glass.

Lead, Carbonate of, in Chem., $PbOCO_2$.—This salt, commonly known as *white lead*, forms, when ground with oil, one of our most important white pigments. The most usual method of manufacturing it in this country is that known as the Dutch method. It consists in exposing lead cast in thin gratings to the combined action of acetic acid vapour, moist air, and carbonic acid gas. The gr[illegible] a little above the bottom of [illegible]lar to flower-pots, in each of which a small quantity of weak acetic acid is placed. The pots are built up in alternate layers with spent tanners' bark, until a stack is formed, each layer of pots being covered with a board. Fermentation soon takes place in the tan, and serves the double purpose of generating heat and furnishing carbonic acid. After the lapse of six or eight weeks, the metallic lead is found converted into white masses of carbonate, mixed with hydrated oxide. It is then levigated, washed, dried, and ground with oil. About 16,000 tons of white lead are annually made in England by this process. Pure carbonate of lead, for chemical purposes, may be precipitated from pure nitrate of lead by an alkaline carbonate.

Lead, Chlorides of, in Chem.—Lead forms with chlorine a sparingly soluble white precipitate when a solu[illegible] with a soluble salt of lead. If [illegible] horny mass, which may [illegible]tures. Chloride of lead combines with the oxide to form oxychloride in several proportions. The most important of these ($PbClPbO$) is used as a white pigment, under the name of Pattinson's white. Another ($PbCl7PbO$), known as patent yellow, or Turner's yellow, is also much used for the same purpose.

Lead, Chromates of, in Chem.—Lead forms with chromic acid, two chromates,—the neutral chromate, $PbOCrO_3$, and the dichromate, $2PbOCrO_3$. The former is the well-known brilliant yellow pigment chrome yellow, and is made by precipitating a solution of acetate or nitrate of lead with chromate or bichromate of potash. It is extensively used in the arts both as a pigment and in calico-printing. The dichromate is of a splendid scarlet colour, and is made by adding to a solution of nitrate or acetate of lead a solution of chromate of potash, to which an equivalent of hydrate of potash has been added. It is much used as a pigment.

Lead, Iodide of, in Chem., PbI.—This compound is easily obtained by throwing down the nitrate or acetate of lead by iodide of potassium. It is sparingly soluble in cold water, but more so in hot, from which it is deposited in brilliant yellow spangles. Iodide of lead forms double salts with the alkaline iodides and cyanides.

Lead, Nitrates of.—Of these there are four, of which three are basic, containing one equivalent of nitric acid united to 2, 4, and 6 equivalents of oxide of lead. The neutral nitrate, which is an important salt used extensively in calico-printing, is prepared by dissolving the metal, its oxide or carbonate, in nitric acid,

and crystallizing. Nitrate of lead crystallizes in hard anhydrous octahedra, which are sometimes opaque and sometimes transparent. It is somewhat sparingly soluble in water, requiring seven parts of cold water for solution.

Lead, Nitrites of.—There are several nitrites of lead. Basic nitrite of lead is prepared by boiling metallic lead in the solution of its nitrate. This gives rise to a pink basic nitrate containing four equivalents of base, from which a yellow neutral nitrate may be prepared by passing through it a current of carbonic acid.

Lead, Oxides of.—The principal oxides are the *suboxide*, Pb_2O; the *oxide*, PbO; and the *binoxide*, PbO_2. Several intermediate oxides also exist. Suboxide of lead is made by heating oxalate of lead in an oil-bath to 572° Fahr. as long as any gas is eliminated. It is a black powder, convertible by heat into the oxide. The oxide is known in commerce as *litharge* when obtained by fusion, and as *massicot* when amorphous. It is manufactured in very large quantities by exposing metallic lead to a current of heated air. It varies from the well-known brownish-red of litharge to a pure white, according to the state of aggregation of its particles. It forms numerous salts with the acids. It also forms compounds with the alkalies, which are regarded by some chemists as *plumbites*. It is slightly soluble in pure water. A solution of sugar is capable of dissolving a large quantity. It is employed commercially in the manufacture of white and red lead, in making glass, in assaying, and ... certain kinds of earthenware. The binoxide, peroxide, or plumbic acid, is of a dark purplish-brown, and is formed by heating the protoxide with some powerful oxidizing agent, such as chlorate of potash or nitric acid. It is, in itself, a powerful oxidizing agent, and has been much employed in making certain of the aniline colours. It acts as a true acid, forming a distinct plumbate with potash, crystallizing in colourless cubes. Red lead, or minium, is somewhat uncertain in its composition, but it is now generally regarded as a plumbate of oxide of lead. It is largely used in glass-making, and is one of the commonest of our mineral pigments. It is made by heating litharge, or massicot, in a reverberatory furnace. Miniums containing one equivalent of plumbic acid united with one, two, and three equivalents of oxide of lead, have been analyzed. They differ but slightly in colour and physical properties.

Lead, Sulphate of, in Chem.—This salt occurs in nature as *lead vitriol*, which is found crystallized in transparent octahedra. It is obtained in the laboratory as a white precipitate, by adding dilute sulphuric acid to a ... soluble salt of lead. It is very sparingly soluble in water and in dilute sulphuric acid. It is, however, soluble to a much greater extent in concentrated sulphuric acid; hence the chloride of sulphate of lead thrown down when water is added to the ordinary oil of vitriol made in leaden chambers. It is obtained in large quantities as a by-product in the preparation of acetate of alumina for dyeing, by decomposing sulphate of alumina with acetate of lead.

Lead, Sulphide of, in Chem.—The sulphide of lead occurs abundantly in nature, in the form of galena, which is the principal ore from which this metal is obtained. It may be obtained artificially by fusing sulphur with metallic lead, or by passing sulphuretted hydrogen through a solution of the metal.

Lead, Tartrate of, in Chem.—This salt is principally remarkable for forming the *lead pyrophorus* of the old chemists. Tartrate of lead is made by precipitating acetate of lead by tartrate of ammonia, washing and drying. If a little of the dry tartrate is heated in a test tube until it is decomposed into finely divided lead and carbon, and scattered on a piece of paper, it burns with a red flash.

Lead-tree, in Chem.—A piece of zinc twisted into a fanciful form, and suspended in a bottle containing a solution of acetate of lead, precipitates the metal in arborescent crystals, forming the well-known lead-tree, or Saturn's tree.

Leader, *le'-der* (Ang.-Sax.), in concerted music, is that performer who plays the principal violin, and receives the time and style of the various movements from the conductor, and communicates them to the rest of the band. After the conductor the leader holds the most important place in the orchestra, as all the other performers look to him for direction in the execution of the music, and the entire effect depends in a great measure upon his skill and judgment.

Leading Note, *le'-ding*.—The seventh note of the scale of any key, when at the distance of a semitone below the key-note, is so called. By this note the scale is known, and its tonic or key-note discovered. For example, in the key of two flats, the leading notes are A natural or F sharp; A natural leading to B flat, and F sharp to G natural; the key-note of this key being either B flat or G natural.

Leaf, *lefe* (Sax. *leafe*), the organ which, in the higher orders of plants, is specially concerned in the elaboration of the various vegetable secretions. It invariably grows from the stem, and is generally a flat expanded body, formed of parenchyma or vegetable tissue, strengthened by a woody framework or skeleton. The parts of the stem from which the leaves spring are called *nodes*; and the spaces between such parts, *internodes*. The leaf usually grows horizontally; so that one surface looks to the sky and the other to the earth; but in some plants the leaves are placed vertically, with their edges directed to those points. The latter mode of growth is rare, and the terms *upper* and *lower* are generally applied to the two surfaces. The part of the leaf next the stem is called the *base*, the opposite extremity the *apex*, and the lines connecting these two points the *margins* or *edges*. The angle formed by the upper surface of the leaf with the stem is styled the *axil*, and everything which springs from this angle is said to be axillary. The leaf is sometimes articulated with the stem, and when it falls off, a scar remains; at other times it is continuous with it, and then decays gradually without dropping off. When leaves fall off annually, they are said to be deciduous, when they remain for two or more years, they are *persistent* or *evergreen*. A leaf usually consists of two distinct parts,—a flat expanded portion called the *blade*, *lamina*, or *limb*, and a narrower portion which joins it to the stem, and which is termed the *petiole* or *leaf-stalk*. The apex of the blade is the oldest part of such a leaf, and the base of the stalk the youngest. When a leaf has no distinct stalk, but consists of the flat portion only, it is said to be *sessile*. The occurrence of two little organs at the base of the leaf-stalk is frequent; and as these usually resemble the ... part of the leaf, they have been termed *stipules*, or little blades. But

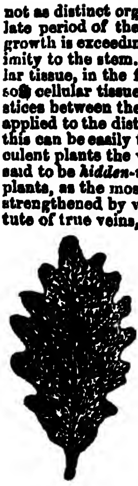
LEAF OF THE PEAR.
a, blade.
b, petiole.

SESSILE LEAVES OF THE BOX.

STIPULES OF THE ROSE.

though commonly of a leafy character, stipules sometimes take such curious forms that they can only be distinguished by their position at the base of the petiole, or the blade if the leaf be sessile. In the rose, the stipules appear as little membranous parts adhering to the base of the leaf-stalk. In the common mallow, and in the geranium, they take the form of little leaves, and proceed not from the leaf-stalk, but from the stem of the plant, at either side of the base of the leaf-stalk. In the wild heartsease they are extremely large, and are divided into several segments. In the robinia they occur as sharp prickles, and in the smilax as delicate tendrils. Stipules, when present, whatever their form, are to be regarded as portions of the leaf, and

not as distinct organs. They appear at a somewhat late period of the development of the leaf, but their growth is exceedingly rapid, owing to their close proximity to the stem. Leaves generally consist of vascular tissue, in the form of *veins*, *ribs*, or *nerves*, and of soft cellular tissue, or *parenchyma*, filling up the interstices between the veins. The term *venation* has been applied to the distribution of the veins. In most leaves this can be easily traced; but in the case of some succulent plants the veins are obscure, and the leaves are said to be *hidden-veined*. Again, in the lower tribes of plants, as the mosses and seaweeds, the leaves are not strengthened by vascular tissue, and from being destitute of true veins, they have been termed *veinless*. In an ordinary leaf there may be observed a central vein larger than the rest, which is called the *midrib*; this gives off veins laterally, which either end in curvatures within the margin, as in the leaf of the lilac, or proceed directly to the edges, as in the oak-leaf. The veins give origin to smaller ramifications, which are distinguished by the term *veinlets*. Some leaves, as those of the common sycamore, have, in place of a midrib, three or more large veins, which proceed from the base to different parts of the margin, such veins being simply termed ribs. Leaves in which the veins form a sort of network are said to have a *reticulated* or *netted venation*: the leaves of all our forest trees and most of our herbs are examples. Those leaves in which the main veins are more or less parallel, and simply connected by unbranched veinlets, are said to have a *parallel venation*:



RETICULATED LEAF OF OAK, SKELETON.

PARALLEL-VEINED LEAF OF THE BANANA.

the grasses, lilies, palms, and most monocotyledonous plants, furnish examples. Leaves have been divided into *simple* and *compound*. A leaf is simple if it has only one blade, however much this may be divided: the pear, the oak, the lilac, and the cabbage, have simple leaves. A leaf is compound when the blade is separated into two or more distinct portions, each of which bears the same relation to the petiole as the petiole itself bears to the stem from which it arises. The separate portions of a compound leaf are called *leaflets*; and these may either be sessile or furnished with stalks, called *petiolules*, or *partial petioles*; the main axis which supports them being termed the *rachis* or *common petiole*. The leaflets of a compound leaf may be at once distinguished from the separate leaves of a branch by their being all situated on the same plane; moreover, the entire leaf, when it dies, commonly falls off the stem in one piece, and not leaflet by leaflet. The leaves of the rose, clover, elder, and horse-chestnut are familiar examples. The margins of leaves are sometimes smooth and undivided, but more frequently indented or scalloped. A leaf is said to be *entire* when its margins are smooth, as in the garden nasturtium and the whole orchis tribe. Of the *indented* or *toothed* leaves, botanists name several varieties, the following being the principal:—

SERRATE LEAFLET OF ROSE.

Serrate.—Having teeth, like those of a saw, directed towards the apex; as in the common nettle.

Biserrate.—With teeth which are themselves serrate, as in the nettle-leaved bell-flower.

Serrulate.—Minutely serrate; that is, having very small teeth.

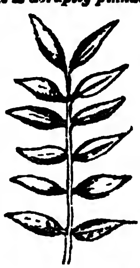
Dentate.—With large sharp teeth, not pointing in any particular direction.

Crenate.—Having rounded projections in place of angular teeth; as in the ground-ivy and the horse-radish.

Bicrenate.—With rounded projections which are themselves scalloped.

Crenulated.—Minutely scalloped.

A simple leaf is sometimes more divided than in the above instances, and the segments produced receive different names, according to their nature. If the incisions reach about midway between the margin and midrib, or petiole, the leaf is said to be *cleft*, and its divisions are called *lobes*; if they extend almost as far as the midrib, or base, the leaf is *partite*, and the divisions are then termed *partitions*; and if they quite reach the midrib, or base, *segments* are formed, and the leaf is said to be *dissected*. These segments differ from the leaflets of a compound leaf in never being articulated, and also in each being united to the midrib or petiole by a broad base. In describing incised leaves, such terms as *bifid*, or two-cleft; *trifid*, three-cleft; *multifid*, many-cleft; *tripartite*, *trisected*, and so on, are generally used. Special terms are applied to the various modifications of the compound leaf. It is *pinnate* when the leaflets (or *pinnæ*, as they are sometimes called) are arranged along the rachis in pairs; it is *abruptly pinnate* when it ends with a pair of leaflets, and *unequally pinnate*, when there is a single terminal leaflet. Sometimes the leaflets of a pinnate leaf are themselves so divided as to appear pinnate; such a leaf is *bipinnate*. The secondary leaflets, or *pinnules*, as they are termed, may in like manner become pinnate, and so produce a *tripinnate* leaf. When the division extends beyond this point, a *decompound* leaf is the result: examples are afforded by many umbelliferous plants. In many compound leaves the leaflets proceed from the same point instead of being arranged along each side of a common stalk. If such a leaf consists of three leaflets, it is *ternate*, as in the strawberry; *quadrinate* if there are four, as in herb Paris; *quinate* if there are five; *septernate* if there are seven, as in the horse-chestnut; and *multifoliate* if there are more than seven, as in lupin. These leaves, like those which are pinnate, may be again divided and subdivided; thus the common petiole may divide at its apex into three partial ones, each of which bears three leaflets; such an arrangement producing a *biternate* leaf. (For further information respecting leaves, *see* the articles BOTANY and PHYLLOTAXIS.)



ABRUPTLY PINNATE LEAF.

TERNATE LEAF OF STRAWBERRY.

SEPTERNATE LEAF OF HORSE-CHESTNUT.

LEAGUE, *leeg* (Fr. *ligue*), in Pol., is an alliance entered into between two or more powers, for the purpose of carrying out some common enterprise.

LEAGUE, SOLEMN, AND COVENANT, in Eccles. Hist. (*See* COVENANT.)

LEAGUE, THE HOLY, in French Hist., was an association formed in the early part of the reign of Henry III., at first with the view of uniting all parties in the Roman Catholic church against the Protestants; but the princes of Guise having placed themselves at its head, changed its character, and induced it to adopt the project of placing the duke of Guise upon the

throne. At the instigation of the league, the citizens of Paris expelled Henry III. on the day of the Barricades, 1588. After the death of Henry, in 1591, much division arose as to the choice of a successor; the league party were defeated; and from that time their power was at an end, although they continued to exist for some time after.

Leakage, *leek'-āj* (Ang.-Sax.), in Com., is an allowance made on liquids for what may be lost by leaking.

Leap-Year, or **Bissextile**. (*See* **Bissextile**.)

Lease, *lesse* (Ang.-Nor), in Law, is defined to be "properly a conveyance of any lands or tenements (usually in consideration of rent or other annual recompense) made for life, for years, or at will, but always for a less time than the lessor has of the premises; for if it be for the whole interest, it is more properly an assignment than a lease." The usual words employed to constitute a lease are—"demise, grant, and to farm let," from the Latin *demisi, concessi, et ad firma tradidi*. By this conveyance, an estate for life, for years, or at will, may be created, either in corporeal or incorporeal hereditaments. By the Statute of Frauds (29 Car. II. c. 3), all leases, estates, interests of freehold, for terms of years, are required to be in writing, otherwise they would have the force and effect of leases or estates at will, only except in the case of leases for a term not exceeding three years from the making thereof, upon which the rent shall amount to at least two-thirds of the full value of the thing demised. The act 8 & 9 Vict. enacts that a lease required by law to be in writing, made after 1st October, 1845, shall be void in law unless made by deed; but leases which are not required to be in writing, *i. e.*, leases for periods not exceeding three years, are not affected. By the common law, all persons seised of any estate might let leases to endure as long as their own interest lasted, and therefore tenants in fee might let leases of any duration; but a tenant in tail, or for life, could make no leases which should bind the issue in tail or reversioner, nor could a husband, *jure uxoris*, make a valid lease for a longer term than the joint lives of himself and wife, for then his interest expired. Yet some tenants for life, where the fee-simple was in abeyance, might (with the concurrence of such as had the guardianship of the fee) make leases of equal duration with those granted by tenants in fee-simple; such as parsons and vicars, with consent of the patron and ordinary. These laws have been changed by various statutes, and now all parsons and vicars, colleges, cathedrals, and other ecclesiastical or eleemosynary corporations, are restrained from making any leases of their lands, unless under the following regulations:—1. They must not exceed twenty-one years, or three lives, from the making.—2. The accustomed rent, or more, must be yearly reserved thereon, and the premises demised must have been commonly letten.—3. Houses in corporations or market-towns may be let for forty years, provided they be not the mansion-houses of the lessors, nor have above ten acres of ground belonging to them, and provided the lessee be bound to keep them in repair. By 6 Wm. IV. c. 20, certain provisions are made with respect to the renewal of leases granted by ecclesiastical persons; by 5 Vict. c. 27, incumbents of ecclesiastical benefices are allowed to demise the lands belonging to their benefices on farming leases; and by 5 & 6 Vict. c. 108, ecclesiastical corporations, both aggregate and sole, are allowed to grant leases for long terms of years, for building and other purposes of improvement; but the provisions of these statutes are so numerous that we cannot enter upon them. Leases in general require either an *ad valorem* or a common deed stamp.

Lease and Release, in Law, is one of those modes of conveyance which has been swept away by recent legislation, but which was formerly in very common use. Before the passing of the Statute of Uses (27 Hen. VIII. c. 10), it appears that a lease for two or three years was sometimes made and perfected by entry of the lessee, for the single purpose of his afterwards receiving a release of the reversion; and hence arose a sort of compound conveyance, called lease and release. After the passing of the Statute of Uses, which operated so as to give an estate in land without entry, this mode of conveyance became very common. A lease, or rather bargain and sale, upon some pecuniary consideration, for one year, was made, or supposed to be made, by the tenant of the freehold to the lessee or bargainee, and this, without any enrolment, made the bargainor stand seised to the use of the bargainee, and vested in the bargainee the use for the term of a year. He was thus capable of receiving a release of the freehold and reversion which could only be made to a person having a vested interest; and, accordingly, the next day a release was granted to him. This was held to supply the place of livery of seisin, and so a conveyance by lease and release was held to amount to a feoffment. Not only estates in possession, but estates in remainder and reversion, as well as incorporeal hereditaments—indeed, all that could be conveyed to uses, might be conveyed by lease and release. The lease for a year has been rendered unnecessary by act 4 Vict. c. 21, which declares that every deed of release executed after 15th May, 1841, and said to be in pursuance of this act, shall be effectual and take effect as a conveyance to uses or otherwise, equally as if the releasing party or parties had also executed in due form a lease for a year. Subsequently, the act 8 & 9 Vict. c. 106, by enacting that all corporeal hereditaments shall be deemed to lie in grant as well as in livery, took away the necessity of a release. The stamp duty chargeable on the lease and release continued to be charged on the deed of conveyance till abolished by 13 & 14 Vict. c. 97.

Leash, *leesh* (Fr. *lause*, from Lat. *laqueus*, a thong of leather), a term employed by sportsmen with regard to game, &c., in order to signify three, or one brace and a half; as a leash of hares, a leash of partridges. It also signifies a line to hold dogs by, especially hounds in coursing.

Leather Manufacture, *leth'-er* (Germ. *leder*, leather), the process by which the skin of any animal is rendered fit for making various articles of common use, such as boots, shoes, gloves, saddles, harness, coverings for books, belts for machinery, buckets, hose for fire-engines, &c. The skins of the larger animals, such as oxen, horses, and buffaloes, are called hides, while the skins of pigs, sheep, calves, lambs, goats, dogs, rats, and seals, are known in the leather trade by the unaltered name. The hides which furnish the thickest leather in ordinary use are sent from South America, and are taken from the cattle that roam in vast herds, and in an almost wild state, over the vast *pampas* of that continent. The hides of bulls are thicker than those of oxen, which are, in their turn, stouter and stronger than the hides of cows. The leather made from these hides is used for the soles of boots and shoes, soldiers' belts, and all purposes for which leather of a thick and durable kind is required. The hides of horses are generally used for making harness. Calves' skins are used for the upper leathers of boots and shoes, being thinner and more supple; they are also used in bookbinding. The skins of sheep afford a still thinner and cheaper kind of leather, which is useful for a variety of purposes, such as leather aprons, the coverings of chairs, shoes, whip-lashes, bags, &c. Wash leather is also made from the skins of sheep, and leather for the inferior kinds of bookbinding. The skins of dogs, lambs, goats, kids, and rats, are chiefly used in glove-making, some furnishing materials for the finer kinds of ladies' shoes. Seal-skins supply a soft and durable leather for boots and shoes, and pig-skins are used entirely for making saddles. The appearance of the skins of various animals, when converted into leather, is widely different; but this is entirely due to the difference in the processes to which they have been subjected. There are three methods of preparing hides and skins for the uses which have been enumerated, which are known as tanning, tawing, and chamoying. Either operation prevents the decay of the skins, which would be a natural consequence if they were left in the state in which they were stripped from the carcass. In tanning, the change is due to the chemical action of an astringent matter contained in many vegetable substances, but principally in the bark of the oak, larch, and willow, which converts the soluble skin, that consists entirely of gelatin after the hair and scarf-skin have been removed, into the hard and insoluble substance which is called leather. When foreign hides are brought to the tanner, they require to be soaked and beaten to make them as supple as pos-

sible, since they must necessarily be salted or dried previous to exportation, which renders them stiff and hard, and unfit to be subjected to the tanning process without the preliminary treatment that has been mentioned. Fresh hides are merely scraped to remove any pieces of fat or flesh that may still adhere to the inner side, and the horns and hoofs are removed. The hair and scarf-skin, a thin cuticle which covers the skin itself, are then loosened by soaking the hides in lime-water, or by suspending them in a place called the smoke-chamber, where they are subjected for some time to the constant action of moderate heat. After this the hair is easily removed by scraping, and the hides are next plunged into a weak solution of sulphuric acid and water, which has the effect of thickening the hide and opening the pores for the reception of the tannin. This part of the process is technically termed "raising." All that [illegible] remains to be done is to soak the hides in a mixture of oak bark, ground to small fragments in a bark-mill, and water, until they are found to be the[illegible]pregnated with tannin, after which the hides are dried slowly and subjected to heavy pressure by passing them through heavy rollers, or by beating, in order to give substance and firmness to the leather. There are many different methods of applying the astringent solution that converts the hides into leather; but the process of soaking the hides in an infusion of bark and water, which must be renewed as soon as the bark is found to have lost its strength, is considered to be the best. It is also found that leather which has been tanned by the usual slow and gradual process is far more durable than that which has been manufactured more rapidly by the use of very strong solutions; a hide that has been quickly tanned being found to be heavier after the process than one of the same weight originally which has been tanned slowly, and consequently less durable and valuable, as it contains less animal matter in proportion. The time in which the process is effected varies considerably; ordinary leather that is used for the soles of boots and shoes requiring to be soaked for not less than six months, while thicker leather cannot be produced in less time than a year or eighteen months. Many processes have been invented for making leather more rapidly by filling the pores of the hide with the astringent solution by means of mechanical and hydrostatic pressure. Among other methods is one invented by Mr. Preller, in which the hides are covered with a composition made of meal or starch and grease, and then whirled round with great rapidity in a cylinder, into which a jet of steam is admitted at intervals. The inner side of calf-skins, and all thin hides that are used for the upper leathers of boots and shoes, is always pared before they are immersed in the tanning solution, to render them thinner in substance and better fitted for the purpose for which they are intended, and they are curried by the currier after they leave the hands of the tanner, to render them soft and supple. Thin skins used for covering chairs, bookbinding, and other ornamental purposes, are tanned with an infusion of sumach. Among these the most valuable is that which is known as morocco leather, which is made from goat-skins. In the manufacture of what is termed sumached leather, care is taken to remove the lime which has entered the skin while it has been soaking in lime-water, by plunging the skins in an alkaline solution, which acts in much the same way as the solution of sulphuric acid in which hides are plunged previously to their immersion in the mixture of bark and water. The skins are then sewn together so as to form bags, which are filled with a mixture of sumach and water, and distended as much as possible by the injection of air. After the opening has been secured, they are thrown into a shallow vessel containing sumach soaked in hot water, in which they float. When the process of tanning is complete, which is generally effected in a few hours, the skins are unsewn, and washed and dried, after which they are dyed, and the peculiar grain by which morocco leather is distinguished is produced on the surface by means of an instrument, the surface of which is furrowed by numerous grooves. The process by which skins are made into soft leather, chiefly for gloves, is called tawing. The skins are prepared in the same manner as those which are to be tanned; but instead of being immersed in the tanning liquid, they are put into a solution of alum and salt, flour and the yolk of eggs being added to this solution to prepare the skins which afford the better and more delicate kinds of leather. The skins and a quantity of the mixture are put into a cylinder, which is made to revolve with great rapidity, and this causes the skins to become thoroughly impregnated with the preparation in a short space of time. After this they are cleaned, dried, dyed, and worked by the hand over a piece of iron to render them soft and fit for use. Skins that are to be dressed with the wool or hair still on them, are prepared with a solution or paste, in which alum is the chief ingredient. The process of preparing leather which is termed shamoying, and by which chamois or shamoy leather is made, consists in impregnating the pores of the skin thoroughly with oil or grease. The grain surface, or the surface of the side from which the hair has been removed, is entirely taken off by rubbing it with pumice-stone. The skins are then soaked, first in lime-water and next in an infusion of bran and water, or very weak sulphuric acid and water, after which they are beaten in a mill with heavy hammers until no moisture whatever remains in them. Fish oil is then poured on the skins, which [illegible] action of the hammers until the oil has [illegible] beaten into them. This is repeated until the skins have imbibed a sufficient quantity of oil, after which they are hung for some time in a heated room to cause the oil to act completely in every part of the skin. The process is concluded by washing them in a solution of potash, which removes any superabundance of oil that may still remain about the leather. Before any leather, except stiff hard leather for the soles of boots and shoes, can be used, it passes through the hands of the currier, who first soaks it in water and beats it to render it supple. It is then scraped on the inside with a two-handled knife, something like a spoke-shave, and the grain on the outer side is rubbed with pumice-stone, the leather being frequently wetted during this part of the process. After this it is rubbed on both sides with a flat block called a pommel, the surface of which is cut into ridges. This has the effect of making the leather still more supple. It is finally dressed with a circular knife resembling a very flat bowl or saucer, with a hole in the centre, through which the currier inserts his hand in order to grasp the instrument; and with this the skin is pared and brought to a uniform thickness all over. Leather intended for the upper-leathers of boots and [illegible] is dressed with "dubbing," a composition of a gre[illegible]ature. Among other kinds of leather used in the present day, and held in great estimation in times past, those known as buff, Cordovan, Russia, shagreen, and patent or enamelled leather, deserve notice. The buff leather, formerly used for military purposes, was very thick, and pistol-proof. It was made from the hide of the urus, which was common in Western Europe. This animal was called the *buffe*,—whence the name of the leather, which in turn gave its appellation to the colour so called, from the tawny yellow hue which it always presented when new. The Cordovan leather was first made at Cordova, in Spain, from the hides of horses which were dressed to be used with the grain side outwards. The shoemaker derived his old title of "cordwainer" from this leather. Russia leather is tanned with an infusion of willow bark, and derives its peculiar odour from the aromatic saunders-wood with which it is dyed. Shagreen, which is not so much used now as formerly, is prepared by pressing the hard globular seeds of a plant called goose-foot into the leather, which causes it to become very hard and pitted all over with hemispherical indentations. The surface is then scraped until the holes have nearly disappeared, after which the leather is soaked, which causes the indentations to rise again and produce a rough granular surface. After this, the leather is dyed and dressed with oil. Shagreen was much used for mathematical instrument-cases and the cases of watches. Patent leather and enamelled leather are prepared by covering the surface with a kind of japan, in which boiled linseed-oil and vegetable-black are the chief ingredients. The latter is the most pliant, and as it may be folded without cracking the surface that is put upon it, it is used for belts, boots, and

various articles of dress. Although machinery cannot be made available to any great extent in tanning and currying leather, yet a machine has been contrived by which thin skins can be split into three parts, each of which is available for a different purpose, whereas, prior to its invention, a skin could only be reduced by paring, and as what was taken away by the knife was all in little pieces, it was only fit for making glue. The skin is passed through rollers, the upper one of which consists of a number of narrow discs arranged on an iron rod, that it may adapt itself to the varying thickness of the skin passing under it. It is split by the action of a very sharp horizontal knife, which oscillates backwards and forwards, through a short space, with great rapidity, and divides the skin which meets the edge as it emerges from between the rollers. There are many substitutes for leather, among the best of which are the American leather-cloth and vegetable leather. Both are formed by spreading a preparation of India-rubber upon some textile fabric. The latter is made in pieces fifty yards long, and may be made of any desired thickness. Excellent harness is made from it, while the leather-cloth is much used for covering sofas and chairs. Leather is often used for forming imitation carving in wood, by [illegible], or by pressing it when moist into moulds, a [illegible] many pretty articles of ornamental furniture, such as flower-stands, vases, tables, and picture-frames, have been produced by attaching pieces of leather, cut in various shapes, to a foundation of stained wood, the whole being subsequently coated with a transparent varnish. Stamped leather was frequently used for the hangings of apartments in the middle ages.—Ref. *English Cyclopædia—Arts and Sciences*.

Leather, Artificial.—Messrs. Beard & Downing have recently invented a most ingenious method of producing this material, which promises to become a most useful fabric. Their patent also includes improvements in the colouring, dyeing, and finishing of artificial leather, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather-cloth. We borrow the following clear and elaborate description from the *Mechanics' Magazine*, vol. xiv. p. 35.—"The following is the manner in which the process of manufacturing artificial leather is carried out:—One or both sides [illegible] an open linen cloth, are first [illegible] of oils and resins or gums as hereafter described, and a fleece or fleeces of cotton or other fibre are made to adhere thereto by means [illegible] pressing-rollers. The most ready method is to [illegible]read by the ordinary steam-heated spreading-[illegible]es, the composition on one or both sides of the fabric, and pass the same through steam-heated rolls, also passing through the rolls the fleece or fleeces of fibre on one or both of its sides. When it is desired that the surface of the fleece when on the fabric should be left clean, and not be penetrated too much by the composition, the rollers must be only slightly warm, and not much pressure applied by them to combine the material; when this is not of consequence, a more complete union and a better result will, of course, be obtained by pressing firmly, and allowing the composition to penetrate. In this case it may be necessary to keep the rollers lubricated with ground talc (French chalk), or other convenient substance which will prevent the materials [illegible] to them, and [illegible] [illegible] they are wound off, or from the pressing-rollers. The fabric and fibre thus combined should then be hung in a warm temperature, that it may completely dry thereby the oil composition becomes perfectly oxidized. It will then be insoluble by the oil compositions usually employed in the manufacture of leather-cloth which can then be spread over the surface in successive coats, as is usual in the manufacture of leather-cloth, whereby the side so dressed may be made to assume the appearance of dull or japanned leather, as may be desired. In some cases, in order to obtain increased thickness of fibre, the surface is spread again with the same adhesive composition as at first adopted, and another fleece is attached as before. Ground leather, or other similar dust, is sometimes applied on one side of the fabric, either with or without fibre, so as to give the appearance of leather on the back side of the manufactured material. This may be done by throwing in the ground leather or other dust either in addition, or fibre in the place thereof, as the fabric is passing into the rolls, so that the whole may be pressed together, or the leather or other dust may be applied separately, as directed for additional thickness of fleece. As little composition should be used in uniting the fabric and fibre as will firmly bind all together, so that the manufactured material may remain as soft as possible; but when combined, material may at any stage of the dressing or coating with the ordinary compositions used in making leather-cloth, be dressed with the oils or grease employed in currying leather, which will, as with leather, give softness and flexibility; a small quantity will, of course, suffice. When the artificial leather is to be japanned, then this application of non-drying oil or grease must precede the japanning. The composition for uniting the fabric and fleece is, by preference, made by a mixture of boiled oil or boiled oil and scrapings, and resins or gums, so prepared, that when dried, or solidified by absorption of oxygen, the combined fabric and fibre and composition shall not become hard or brittle, but whilst the adhesiveness and cohesiveness requisite are obtained, the flexibility of dried oil is maintained. The proportions of oil and resinous matter may vary according to purposes and quality of material required to be made therewith, and the kinds of oil and of resinous matter may vary in themselves, and in proportion one to the other, according as their relative qualities and characteristic natures or properties vary, that is to say, that if very hard resins are used, then a greater proportion of non-drying oil may be desirable; also, if a larger proportion of dried oil scrapings is boiled with the oil, then less resinous matter may suffice. The following has, however, been found a good combination —56 lb. linseed oil, 56 lb dried scraping of linseed oil, both boiled to as thick consistency as possible, 7 lb. common resin; 21 lb. Burgundy pitch, 7 lb. commonest india-rubber (if in a resinous state from decomposition it will still avail). The whole having been melted together, add about 5 lb. cod oil or other non-drying oil, grind the whole in convenient steam-heated mixing-rolls, with from 30 to 35 lb white lead (dry) or burnt umber or other driers. This must be spread warm; and if of too thick a consistency, may be thinned with some volatile spirit, such as mineral naphtha. In some cases, in place of applying the oil compositions used in the manufacture of leather-cloth to the fabric coated with fibre, the surface coating of the fibre that has been applied to the fabric is dyed, and for this purpose (by preference) the aniline dyes are employed. The surface of the material may then be varnished with a suitable varnish. In such cases the surface of fibre must be kept clean, at the same time it must be pressed as flat as possible. This surface is then coated with a small quantity of size or albumen, and dyed by floating over it the desired dye, the process being repeated as may be requisite to get a good surface colour, the fabric being pressed between rollers between each coat. The surface may then be varnished with any suitable elastic varnish. In order to colour leather-cloth manufactured as hereinbefore described, or leather-cloth otherwise manufactured, the dyes employed are obtained from aniline and its homologues; this is effected by dissolving the crystals of the aniline dyes in fusil oil that has been rendered anhydrous. To render fusil oil anhydrous gum-arabic is mixed with it, by which the water will be absorbed, the gum-arabic will settle to the bottom of the vessel containing the oil, and the oil may then be drawn off: other means may, however, be employed for rendering the oil anhydrous. The inventors prefer to dissolve in a gallon of oil half an ounce of roseine or other crystals; but this will vary according to the shade of colour desired. When the colour has been dissolved in the oil, two fluid ounces of sulphuret of carbon and one ounce of ether are added to it. In order to colour leather-cloth with this mixture, the surface of the leather-cloth is floated or painted over with it, and the oily compositions of which the surface of the leather-cloth is composed should have pigments mixed with them of somewhat the same colour as the colour with which it is to be subsequently coated. The process may be repeated to get

deeper and richer effects of colour, and spirit varnish may or may not be mixed in small proportions therewith, for all or only the last coat of dye. The coatings of dye dry at ordinary temperatures. In order to produce a bronzed effect on leather-cloth by the use of aniline dyes, the surface is covered with the aniline dyes dissolved in spirit. For this purpose four ounces of roseine, or other crystals, are dissolved in one gallon of pyroxalic spirit; four ounces of acetic or sulphuric ether are added thereto. After coating the surface of the leather-cloth with this solution, it is subsequently coated with any suitable varnish. The advantages gained by the above improvements are, firstly, an artificial leather is obtained, more closely resembling leather by reason of not showing the threads of the fabric on which it is made, as is the case with ordinary leather-cloth. Next, from the fabric and fibre being united with a composition, the artificial leather can be cut with a raw edge without tendency to ravel out, as in an ordinary woven fabric. A much less expensive fabric can also be employed than in ordinary leather-cloth, and at the same time the artificial leather or leather-cloth possesses increased strength. By the dyeing process increased richness of colour is attained at a less expense than heretofore, and a nearer approach to the appearance of leather is gained, together with greater durability than is obtained by the painted and varnished surface of ordinary leather-cloth.

Leaven, *lev'-n* (Fr. *levain*, from Lat. *levo*, I raise), is a piece of sour dough used for fermenting bread. By the law of Moses, leaven was strictly forbidden to the Jews during the Passover; and, in a figurative sense, it is applied to anything that powerfully, but gradually, undermines right principles of heart and life, in opposition to unleavened, denoting sincerity and truth. "The leaven of malice and wickedness;" "the unleavened bread of sincerity and truth."

Lecanora, *lek-ă-no'-ră* (from Gr. *lekane*, a basin, in allusion to the form of the shields), in Bot., a gen. of lichens. The species *L. tartarea* is the principal lichen used in the preparation of the dye called *cudbear*. *L. esculenta* and *affinis* form important articles of food to man and the lower animals in Persia, Armenia, Tartary, &c. They sometimes appear in such enormous quantities as to cover the ground to the depth of several inches. Dr. O'Rorke has endeavoured to prove that *L. esculenta* formed the true *manna of the Hebrews*—that which supported them in the wilderness.

Lector, *lek'-tor* (Lat. *lego*, I read), in the early Christian Church, was a person appointed to read portions of Scripture and other good books to the people. Among the Jews there were persons who performed the office of readers in the synagogue. Both in the synagogue and in the church, any person who was able to discharge the duty was allowed to hold the office of reader; and hence boys of ten or twelve years of age were frequently employed in this way. The raising of this to a distinct office in the church, to which the holders were consecrated by prayer and ceremonies, did not take place before the third century.

Lectualis, *lek-tu-ā'-lis* (Lat. *lectus*, a bed), in Med., a term formerly applied to diseases which confined the patient to bed, and detained him there for some time. The patients themselves would be called "lectuales" when they were confined to bed for a lengthened period by obstinate disease.

Lecture, *lek'-tshur* (Lat. *lego*, I read), strictly and etymologically, signifies a discourse read; but commonly it is used in a more general sense, to denote any formal or methodical discourse intended for instruction. The communicating of instruction by means of public lectures has been in use from the earliest times, and, when properly conducted, it has advantages over every other mode of teaching. For that purpose, however, it is necessary that the matter be drawn up and arranged in an easy, natural, and consecutive manner, and that it be delivered in an attractive mode. It is to be regretted, however, that lectures are generally got up, not so much with a view to instruct the hearer, as rather to exhibit the attainments or propagate the prejudices of the lecturer. "Perspicuity of statement is the first and highest quality of a lecturer," without which "other qualities can avail little or nothing. To attain this essential quality, the subjects of the lecture should be so arranged that they may follow each other naturally and easily; the sentences should be clear and distinct, neither too long nor too short; the illustrations should be apposite, and of a kind fitted to excite and keep awake the attention of the hearer; and the lecture so composed should be delivered in a plain, distinct, and impressive manner."—(*Brande's Dictionary.*) In the Scotch and continental universities, as well as in those recently established in England, instruction is communicated chiefly by means of lectures. In such cases, each lecture should be followed up, next day, by a searching examination of the students on the subjects treated of, and explanations given of such difficulties as may have occurred to them. On this subject the remarks of the late Professor Jardine, of Glasgow, are worthy of attention. "A professor," he says, "in composing lectures to be delivered to young persons, must be supposed to have studied the several branches of knowledge which he teaches with a reference to this particular end; to have selected and adopted every topic which he introduces into them with a strict regard to the capacity and previous acquirements of his pupils, as well as to the precise point to which he proposes to conduct them in their progress through science. He must be supposed to have read and thought for his students nearly as they might be imagined to read and think on the subjects which *he* is about to communicate to them; not, indeed, that he may thereby do their work for them, but that, on the contrary, he may occupy their time and their industry with the most important, the most suitable, and consequently the most useful studies. In the prosecution of these objects it ought to be the aim of the teacher, in every part of his lectures, to lay before his students, at the proper time, those particular elements of knowledge with which they ought to be first acquainted; to facilitate their progress towards more recondite subjects of inquiry; to prevent all unnecessary labour; to obviate all perplexity; to assist all their endeavours; and gradually to lead them into those paths which will guide them with ease and certainty to still higher degrees of scientific attainment." —*Outlines of Philosophical Education.*

Lecythidaceæ, *le-se-thi-da'-se-e*, in Bot., the Brazil-nut or Monkey-pot order, a nat. ord. of *Dicotyledones*, sub-ord. *Calyciflora*. Large trees, with alternate dotless leaves, and small deciduous stipules. Flowers large and showy; calyx superior; petals 6, imbricated, distinct, or sometimes united at the base; stamens numerous, epigynous,—some of them cohere and form a unilateral petaloid hooded body; ovary inferior, 2- to 6-celled; placentas axile. Fruit woody, either indehiscent or opening in a circumscissile manner. Seeds several, large, and without albumen. The *Lecythidaceæ* are principally natives of Guiana and Brazil. They are remarkable for their large woody fruits, the pericarps of which are used as drinking-vessels, &c. Their seeds are frequently eaten. (*See* Bertholletia, Lecythis.)

Lecythis, *les'-e-this* (from Gr. *lecuthos*, an oil-jar), in Bot., the typical gen. of the nat. ord. *Lecythidaceæ*. The fruits of *L. ollaria* and other species are termed *monkey-pots*, and contain large edible seeds, some of which have lately been imported under the name of *Sapucaya nuts*. The bark of some species of lecythis separates into thin papery layers, which are used as wrappers for cigarettes by the Indians.

Ledum, *le'-dum* (from Gr. *ledon*, a plant now called *Cistus Ledon*), in Bot., a gen. of the nat. ord. *Ericaceæ*. An infusion of the leaves of *L. palustre* and *latifolium* is used in North America as a substitute for China tea, under the name of Labrador tea, or James's tea. It possesses narcotic properties.

Lee and **Leeward**, *lee, lu'-ward* (Ang.-Sax.), terms generally applied to the side of a ship, or the quarter opposite that from which the wind blows, the latter being termed the windward side or quarter, or the *weather side*. A *lee shore* is that on which the wind blows, or, in other words, is on the lee side of a ship. A vessel is also said to be *under the lee* of a shore when the wind blows off the land. The terms windward and leeward are likewise applied to some islands in the West-Indian group, in consequence of the direction in which they lie in a voyage from Port of Spain to Carthagena. The Leeward Islands extend from

Demerara to Porto Rico, and include Grenada and many others.

Leech, *leetsh* (Sax. *laecan*, Lat. *hirudo*, from *haurio*, I draw), a genus of red-blooded worms, or annelide animals, which have an oblong body, with a sucker at one end and a mouth at the other. In the mouth there are three small jaws, tongues, or plaits of skin by which they are enabled to extract the blood of other animals, which forms their principal nourishment. Leeches are oviparous, and take nearly five years to arrive at maturity. They are found in ponds and rivers in nearly every country; and derive their chief interest from their use as a remedial agent. The species generally employed for medical purposes belong to the genus *Sanguisuga*. Of this genus two species are employed in Europe,—*S. officinalis*, the Hungarian, or green leech, used in the south of Europe, and the *S. medicinalis*, the German, brown speckled, or English leech, used in the north of Europe: the latter variety is now rare in this country, on account of the draining of so many marshes, bogs, and ponds, where it was formerly abundant. The same is nearly the case with France, which is now principally supplied from the frontiers of Turkey and Russia. The large number of leeches used in England are mostly derived from Sweden, Hungary, and Poland. The English, or speckled leech, is composed of from ninety to one hundred rings, is convex on the back which is olive-green in colour, with six red longitudinal stripes spotted with black. The belly is flat, greenish-yellow, spotted with black. The oral and caudal extremities are narrowed before they spread out into discs or suckers, and the anterior extremity is rather narrower than the caudal. The sucker at the tail is an organ of prehension, or holding, by which the animal is enabled to progress. The leech breathes by pores, which open into small vesicles ranged on either side. The stomach occupies two-thirds of the length of the animal, and is divided into eleven compartments, each furnished with two cæcal sacs; it is closed by a sphincter valve at its lower end. The leech has no heart, but four large pulsating vessels instead one on each side, one on the dorsal, and the fourth on the abdominal surface. In its native abode, the true medicinal leech seems to take no solid food, but subsists entirely on the fluids of fish, frogs, &c. They are caught in various ways,—by the hand, or by a person wading in the shallow waters during the spring season, when they adhere to his naked legs; but in summer, when they retire to deeper water, a raft is constructed of twigs and rushes, by which a few are entangled. They are sometimes taken by means of decayed animal matter or liver, as bait; but this method is considered injurious to the health of the animal. If active in the water, and plump when taken out, a leech may be known to be in good health. Leeches vary in the quantity of blood which they can abstract, from one drachm to half an ounce: from one to two drachms is the average. When forcibly pulled away whilst sucking, the leech is very apt to leave the teeth, or plaits of skin, in the wound, giving rise to pain and inflammation of the part; the leech is also rendered incapable of biting again. One of the most certain methods of making leeches bite is to cleanse the skin thoroughly; and the leeches should be exposed to the air for a short time previous to their application, as by this means they will bite more eagerly. They may be applied to the part by holding them lightly in the fingers, if they are voracious; or they may be placed in a cup, which should be inverted over the part from which the blood is to be drawn. A leech should not be disturbed whilst sucking, but should be permitted to fall off. When it has dropped off, it should be seized by the tail, and striped between the finger and the thumb, in order to make it disgorge most of the blood, allowing it to retain about one-third,—this is better than applying salt or vinegar to the mouth; it should then be placed in many successive fresh waters, when it may survive, and after many months be again fit for use. The increasing scarcity of leeches renders their propagation and preservation matters of great importance; and large numbers die through errors in the method of keeping them. Leeches have not been observed to propagate when kept in small bodies of water; but in large reservoirs, with a bottom of turf and rushes and clay sides, in which to deposit their cocoons, they have been known to propagate. The consumption of leeches in this country has greatly diminished of late years. A short time ago, four of the principal dealers in London used to import 7,200,000 annually. According to the French official returns in 1847, the number of leeches imported into France was 23,581,680, the value of which was estimated at 353,710 francs.

Leek, *leek* (Sax. *leac*), (*Allium Porrum*), a hardy biennial plant. Although the leek attains perfection in size and for culinary purposes in the first year, it does not run to seed until the second, the perfecting of which it often also survives. The whole of the plant is eaten, being used in soups, &c., and by some persons is boiled and eaten with meat. There are four varieties,—the Musselburgh and the large London leek, which are by far the best; the Scotch, or flag, which is larger and harder; and the Flanders. The leek is raised solely from seed. (*See* Allium.)

LEEKS.

Leet. (*See* Court Leet.)

Leg, *leg* (Du. *leg*), is commonly applied to the whole of the lower limb from the hip to the ankle, but which properly belongs to that portion which extends from the knee to the ankle, the upper portion being the thigh. The leg proper is formed of two bones,—the tibia and fibula. The former of these is the larger, and articulates above with the os femur, or thigh-bone, presenting for that purpose two articulating surfaces,—an external and internal, known as the condyles of the tibia, and separated from each other by a large bony prominence termed the spine, and two rough surfaces, one in front the other behind the spine. Below the articulating surface, and in front, is a large eminence termed the tubercle, which gives insertion to the ligamentum patellæ. On the outer side of the tibia is a projection marked inferiorly by a smooth surface for articulation with the upper extremity of the fibula. The body or shaft of the tibia is large and triangular above, but becomes smaller and more circular inferiorly to the inferior or tarsal extremity, where it expands and assumes a quadrilateral form. Internally it descends farther than in any other direction, forming a projection termed the internal malleolus: externally is a rough triangular surface which gives lodgment to the fibula and attachment to the ligaments which connect these bones together. It articulates below with the astragalus. The superior extremity, or head of the fibula, is round and irregular, and presents, on its inner side, a smooth cartilaginous surface for articulation with the tibia. The tarsal extremity is large, and more prominent than the superior, and forms a large irregular projection of a triangular shape, termed the external malleolus. It articulates with the astragalus. The principal muscles of the leg are the tibialis anticus, extensor digitorum longus, extensor pollicis proprius, peroneus tertius, peroneus longus, peroneus brevis, gastrocnemius, plantaris, soleus, popliteus, flexor longus digitorum perforans, tibialis posticus, flexor pollicis longus.

Legacy, *leg'-ă-se* (Lat. *lego*, I bequeath), in Law, a bequest or gift of goods and chattels by testament. The person to whom it is given is styled the legatee, which every person is capable of being unless particularly disabled by common law or statutes. The bequest confers only an inchoate property on the legatee, for the legacy is not complete till the assent of the executor has been obtained; for in the event of a deficiency of assets, all the *general* legacies must abate proportionally, in order to pay the debts; but a specific legacy does not abate at all, unless there be not sufficient without it. A general legacy is when it is so given as not to amount to the bequest of a particular thing or particular fund; a specific legacy is a bequest of a specified thing or a specific part of the testator's estate. A specific legacy has this disadvantage, that if the subject specified be lost or disposed of by the testator during his lifetime, the legacy is said to be adeemed, or taken away, and the legatee is not entitled to any satisfaction out of the

estate. Thus, the bequest of a particular horse, which is afterwards disposed of by the testator during his lifetime, does not entitle the legatee to another horse in lieu of it. If a legatee dies before the testator, the legacy is lost or lapsed; and if a contingent legacy be left to any one, and he dies before that time, it is a lapsed legacy. A legacy, however, to be paid when the legatee attains the age of twenty-one years, is a vested legacy, and is payable to his representatives if he be dead before that time; but if such legacies be charged upon a real estate, they shall lapse for the benefit of the heir. By act 1 Vict. c 26, however, it is provided that legacies bequeathed to a child, or other issue of a testator, do not lapse in the case of his predeceasing the testator, if he shall have left issue who shall be living at the testator's death, unless a contrary intention appear by the will. As a general rule, legacies are payable twelve months after the death of the testator, and with interest from that time at the rate of four per cent., unless some special provision is made as to the time of payment and interest. A duty is payable to government on legacies of the value of £20 and upwards, but a legacy to a husband or wife is exempt from duty. The duty on a legacy to a child, the husband of a child, a parent, or any lineal ancestor or descendant of the deceased, is at the rate of £1 per cent.; to a brother or sister, or their descendants, £3 per cent.; to an uncle or aunt, or their descendants, £5 per cent.; to a grand uncle or grand aunt, or their descendants, £6 per cent.; to any other relation, or any stranger in blood, £10 per cent.

Legate, *leg'-ait* (Lat. *legatus*), is an ambassador, or nuncio, of the pope, usually a cardinal or bishop, sent to a foreign court. Legates are of several kinds:— *Legati a latere*, legates sent from the side, or the immediate presence, of the pope, and invested with most of his functions. *Legati nati* are such as hold the office as annexed to some other office, or *ex officio* *Legati dati*, or special legates, were such as were despatched on a special mission, and were *pro tempore* superior to the other two orders.

Legatine and Provincial Constitutions, *leg'-a-teen*, are a kind of national canon law adapted to the exigencies of this church and kingdom. The legatine constitutions were ecclesiastical laws enacted in national synods, held under the cardinals Otho and Othobon, legates from popes Gregory IX. and Clement IV., in the reign of Henry III. The provincial constitutions are principally the decrees of provincial synods, held under divers archbishops of Canterbury, from Stephen Langton, in the reign of Henry III., to Henry Churchill, in the reign of Henry V., and adopted also by the province of York in the reign of Henry VI.

Legend, *lej'-end*, or *le'-jend* (Lat. *legenda*, something to be read), as generally [illegible] or doubtful narrative, as the [illegible] of the heroes of the middle ages. Originally [illegible] book containing [illegible] of the Roman Catholic church. Subsequently the word came to be applied generally to books containing lives of the saints, and which abounded with incredible and ridiculous stories. These were recommended to the laity to be read, as affording evidence of the truth of the Catholic religion. One of the best known of these is the Golden Legend, compiled by James de Varase, about 1290, and containing many absurd stories; hence the word came to be used by Protestants to signify any incredible or unauthentic narrative.

Legerdemain, *lej'-er de-main'* (Fr., light of hand), denotes sleight-of-hand, or jugglery, those deceptive tricks which are owing, either entirely or mainly, to dexterity and address.

Legion, *leje'-un* (Lat. *legio*, from *legere*, to choose, select), the name given to a division of the Roman army, which corresponded to a great extent, both in numbers and constitution, to a brigade of the English army. The legion was first instituted by Romulus, shortly after the foundation of Rome. As the rising state was chiefly composed of fugitives from various parts of Italy, and men who were proscribed in their own country for criminal and political offences, and as its rapid growth soon provoked the jealousy of the surrounding states, it was necessary to give a military organization to the inhabitants of the new city, and Romulus accordingly enrolled three bodies of 3,000 men each for active service, each of which was levied from one of the three tribes into which he had divided his people. These bodies he called legions, and each was commanded by an officer of high rank, styled a prefect (from *praficere*, to set before or over) or tribune, whose rank may be considered as equivalent to that of a general officer in our own service. The legion was originally divided into smaller bodies of 100 men each, called *manipuli*, or maniples; but, subsequently, when the strength of the legion was increased, each legion was divided into ten cohorts, each cohort into three maniples, and each maniple into two *centuriæ*, or centuries. Considering a Roman legion to correspond to a brigade in our own army, each cohort would be equivalent to a regiment, though not equal to it in point of numbers, and each century would be equivalent to a company. Each century, which varied in numbers at different times, but which consisted of 100 men, like the original maniple, when at its maximum strength, was commanded by a centurion, who had under him two sub-centurions and a standard-bearer, besides decurions. In these we find the equivalents to our own captain, lieutenant, ensign, and non-commissioned officers of a company. Two centuries composed a maniple, and the senior centurion of the maniple, styled *centurio prior*, probably took command of the entire body, as the senior captain takes the command of two or three companies of volunteers enrolled in the same town, whose complement is not sufficient to entitle them to have a major in command, under the title of captain-commandant. Three maniples composed a cohort. Thus, a legion consisted of ten cohorts, which were divided into thirty maniples, and again subdivided into sixty centuries; and as each century consisted of 100 men, the maximum strength of a legion was 6,000. Each centurion carried a vine rod as the emblem of his authority, and the senior centurion of the entire legion was called *centurio primi pili*, and [illegible] principal standard, or eagle of the legion, was confided. In addition to the main body of infantry, about 300 horse-soldiers were attached to each legion, who were drawn up on the wings when the legion was about to enter into action. These were divided into ten *turmæ*, or troops of thirty men each. The foot-soldiers composing a legion were also distinguished as *hastati*, *principes*, and *triarii*, of which the last-named were veteran troops. When the legion was drawn up in order of battle, the hastati occupied the first rank, in ten bodies, each consisting of ten ranks of sixteen men each. The principes were drawn up in rear of the hastati, in bodies of similar extent, the triarii being in the rear of the principes, but in six ranks of ten men each. Thus, the hastati [illegible] in the battle, the principes forming, as it were, the supports, and the triarii the reserves. Each cohort had its regular number of these three [illegible] of troops. When in battle-array, the Roman soldiers were drawn up in open order, that each man might have room to use his weapons. Besides these, who were armed with sword and javelins, a long buckler, helmet, cuirass, and greaves, each cohort had a certain number of *velites*, or light-armed troops, who had no particular station, but acted as skirmishers, being sent in any direction whence they might harass the enemy during his advance. These were armed with slings, light darts, short swords, and circular bucklers. The number of men comprising a legion seems to have varied at different times, but its strength appears to have been as mentioned [illegible] the most famous wars of the Roman empire. Two legions formed a consular army. At first the legions were enrolled for a brief period, whenever their services were required, and were disbanded as soon as the war was over, the men being chosen by lot by the military tribunes from those who were liable to serve; but, in later times, each legion seems to have been kept up as a standing force, being distinguished by a number, and recruited from time to time, as our own regiments are. They were also further distinguished by the names of those who had raised them, or that of the place where they were raised, just as a regiment of our household troops is known as the Coldstream Guards, and the 11th hussars as Prince Albert's Own. The term legion was originally derived from the circumstance of

the tribunes choosing the soldiers that were to form the legion by lot, and as the body was composed of a great many soldiers, the expression was afterwards taken to signify any great number. The name is still applied to bodies of foreign troops in the service of a foreign power. Thus, a German legion was enrolled in England, and temporarily stationed at Shorncliffe, for service in the Crimean war; and the English troops that fought in Spain, in 1835 and subsequent years, in the civil war between the Carlists and the Christinos, under Sir De Lacy Evans, were called the British Legion.

LEGION OF HONOUR, an order of merit instituted by Napoleon in 1802, as a national reward for services of a distinguished character. It was given for military and civil services alike; those who were distinguished in literature, science, scientific discoveries, and commercial pursuits, being equally eligible for the decoration with the soldier and sailor. The order consists of five classes: grand crosses, grand officers, commanders, officers, and chevaliers, of whom there may be any number. Although established by Napoleon when he filled the office of First Consul, it was kept up on the restoration of the monarchy, and has suffered little material change during the revolutions that called Louis Philippe to power and drove him into exile, and those which have raised Napoleon III. to the summit of his greatness. The recipient of the cross of the Legion of Honour is entitled to a small annual pension, which is now fixed at 100 francs. The grand cross of the order was sent by Napoleon III. to the Prince of Wales on the occasion of his marriage.

LEGISLATION, *lej-is-lai'-shun* (Fr., from Lat.), is the making of law. (*See* LAW.)

LEGISLATIVE. (*See* GOVERNMENT.)

LEGISLATURE, *lej'-is-la-ture* (Lat.), in Pol., is applied to the body or bodies in a state vested with the power of making laws: thus the king, lords, and commons in this country constitute the legislature.

LEGITIMACY, *le-jit'-e-ma-se* (Lat.), in Law, denotes a child born in lawful wedlock. (*See* BASTARD, AFFILIATION.)

LEGITIMATE, *le-jit'-e-met* (Lat.), in Pol., denotes what is in accordance with, or not contrary to, the positive law of a country. When the enactments of a government transgress the higher laws of nature, then they too cease to be legitimate. While obedience to civil authority is enjoined both by reason and revelat[illegible] that oversteps its proper province, resista[illegible] to [illegible] may become a duty [illegible] rather, a government to [illegible]mate must be [illegible] established; [illegible] [illegible] come to [illegible] applied to old hereditary [illegible] which may have sprung [illegible] the revolutionary means.

LEGITIMATION, *le-jit-e-mai'-shun* (Lat.), is the act [illegible] which natural children are rendered legitimate.

[illegible] a substance similar to casein, found [illegible] of most leguminous plants. Legumin may be [illegible] from pease or almonds by digesting the [illegible] of the crushed seeds in warm water for two or [illegible] hours. The undissolved portion is strained off, [illegible] the turbid liquid allowed to deposit the starch wh[illegible] holds in suspension; it is then filtered, and the casein is precipitated by dilute acetic acid in the form of a flocculent precipitate, which is washed, dried, powdered, and digested, first in alcohol and then in ether. It is coagulated by rennet, like the casein of milk; and the Chinese make a kind of cheese from pease and beans.

LEGUMINOSÆ, OR FABACEÆ, *leg-u-min-o'-se*, in Bot., a nat. ord. of *Dicotyledones*, sub-class *Calycifloræ*, having the following essential characters:—Herbs, shrubs, or trees. Leaves nearly always alternate and stipulate, and usually compound. Flowers regular or irregular, often papilionaceous (having a fancied resemblance to a butterfly); calyx inferior, 5-parted, the odd division being anterior; petals 5, or fewer by abortion, sometimes entirely wanting, perigynous, odd one, when present, posterior; stamens distinct or coherent, in one or more bundles; ovary superior, simple, and 1-celled; style simple, proceeding from the ventral suture. Fruit usually a *legume*, sometimes a *lomentum*, rarely a *drupe*; seeds 1 or more, with or without albumen. The order may be generally distinguished by having papilionaceous flowers or leguminous fruit. It is divided into three sub-orders; namely,—

1. *Papilionaceæ*.—Petals papilionaceous, imbricated in æstivation, the upper or odd petal exterior; as in the pea, bean, furze, broom, &c.

2. *Cæsalpineæ*.—Petals not papilionaceous, imbricated in æstivation, the upper or odd petal interior; as in the tamarind, cassia, &c.

3. *Mimoseæ*.—Petals equal, and valvate in æstivation; as in the acacia, &c.

The leguminous order is not only among the most extensive that are known, but also one of the most important to man, whether we consider the beauty of the numerous species, which are among the gayest-coloured and most graceful plants of every region, or their applicability to a thousand useful purposes. The Cercis, which renders the gardens of Turkey resplendent with its myriads of purple flowers; the Acacia, not less valued for its airy foliage and elegant blossoms than for its hard and durable wood; the Brazilletto, Logwood, and Rosewoods of commerce; the Laburnum; the classical Cytisus; the Furze and the Broom, both the pride of the otherwise dreary heaths of Europe; the Bean, the Pea, the Vetch, the Clover, the Trefoil, the Lucerne,—all staple articles of culture by the farmer,—are so many leguminous species. The gums Arabic and Senegal, Kino, Senna, Tragacanth, and various other drugs, with Indigo, the most useful of all dyes, are products of other species; and these may be taken as a general indication of the purposes to which leguminous plants are applied. There is this, however, to be borne in mind in regarding the qualities of the order in a general point of view; viz., that upon the whole it must be considered poisonous; and that those species which are used for food by man or animals are exceptions to the general rule, the deleterious juices of the order not being in such instances sufficiently concentrated to prove injurious, and being, in fact, replaced, to a considerable extent, by either sugar or starch.

LEIPSIC, BATTLES OF, *lipe'-sik* (Ger. *Leipzig*).—Twice have the destinies of Germany been decided by arms on the plains of Leipsic,—on 7th Sept., 1631, and 18th Oct., 1813; while a third contest,—that of 2nd Nov., 1642, was by no means unimportant in its consequences. In the first of these the military talents of Gustavus Adolphus, and the superior tactics of the [illegible]s, prevailed over the German Catholic generals Tilly and Pappenheim, and Tilly was shown not to be [illegible] of 35,000 or 40,000 men, 8,000 fell and 3,000 were taken prisoners. The victory was decisive, and Pr[illegible] principles triumphed in Northern Germany. Eleven years later, Torstenson, the Swedish gener[al], defeated at the same place the imperial Saxon troops, under the archduke Leopold [illegible] [illegible]l battle for Germany, and indeed for the whole of Europe, was that of October, 1813. This memorable battle of Leipsic, called by the Germans the great *Völkerschlacht*, precipitated the downfall of Napoleon, already weakened in his resources by the disastrous Russian campaign. He [ha]d assembled his troops in and around Leipsic to the number of about 80,000 or 90,000 men, the corps of Ney and Regnier not having yet come up. The allied forces, amounting to about 120,000 men, were under the command of Prince Schwartzenberg, although the three monarchs of Austria, Prussia, and Russia, were also present. At [illegible]k in the morning of the 16th October, the allied troops put themselves in motion, carried the French outposts, and about 9 o'clock the battle became general. Both parties displayed the most brilliant courage. Wachau was the scene of the most obstinate conflict. From this place Napoleon adopted his favourite measure of making a grand attack upon the enemy's centre. The corps of Ney, which arrived at this juncture, might have decided the day, but Blucher's army, of about 60,000 strong, also made its appearance. The latter had, after an obstinate conflict, driven Marmont out of the village of Mockern, and now threatened Leipsic from that quarter; so that Ney had to be despatched against it, and the decisive moment was lost. At nightfall both armies remained in nearly the same position as they had occupied in the morning; the only decided success

of the French being on the western side of Leipsic, where General Bertrand had driven back the Austrians under Gyulai, and preserved a line of retreat through Lindenau in case of disaster. On the 17th, both armies rested by tacit agreement, and Napoleon, conscious of his weakness, made an ineffectual attempt to procure an armistice. The 18th found his forces, about 160,000 in number, arranged in a semicircle around the north, east, and south of the city; while, to oppose him, Schwartzenberg, strengthened by the arrival of the Russian reserves under Benningsen and Bernadotte's army of the north, brought into the field 300,000 men and nearly 1,100 cannons. Against these odds the French fought with heroic courage. Gradually their circle of defence was narrowed, and at a critical period of the day they were weakened by the defection of large bodies of Saxon and Wurtemberg troops, who immediately turned their guns against their former comrades. The allies having at length penetrated into the suburb of Schonfeld, Napoleon became convinced that the city was no longer tenable, and, taking advantage of a cessation of hostilities, at nightfall commenced a retreat. Amid a scene of the wildest confusion, the French filed off through Lindenau. Early in the morning of the 19th the allies forced an entrance into the city, and a terrible conflict took place with the rear-guard of the French army, who were encumbered with immense trains of baggage and artillery, and a multitude of wounded. To add to their disasters, the bridge over the Elster was blown up too soon, leaving 15,000 soldiers, besides 23,000 sick and wounded, and more than 200 pieces of artillery, in the hands of the allies. Marshal Macdonald succeeded in swimming his horse across the river, but Prince Poniatowski, in attempting the passage, was drowned. The total loss of the French during the three days' fighting is estimated at about [illegible] men; that of the allies at 45,000.

LEMMA, *lem'-mă* (Gr., a thing taken or assumed), in Math., is a term used to denote a preliminary proposition taken as demonstrated for the purpose of being used in the demonstration of a subsequent proposition. Thus propositions in geometry may be taken as lemmas to prove some proposition in mechanics. In logic, a premise taken for granted is sometimes called a lemma.

LEMMING, *lem'-ming.*—The *Myodes norvegicus* is a native of Norway and Finland. It belongs to the family *Murina*, which includes the mouse, rat, and other similarly formed animals. It is about five inches in length, with a tail about half an inch long, and is of a tawny colour, variegated with black. In its habits the *lemming* is extremely peculiar. It subsists entirely on vegetable food, and lives in shallow burrows under ground in summer, and makes long passages under the snow in winter. In Baird's "Cyclopædia of the Natural Sciences," its peculiar habits are thus described:—"The most remarkable feature in the history of the lemming is the periodical emigrations the animals make from one part of the country to another. They descend in great bands from the mountains which divide Nordland and Finmark, eating up everything before them. They pursue their course in a straight line, climbing walls and houses, and not avoiding man himself, should he stand in their way, but attempting to climb over him. Rivers and lakes are swum across, the band forming again on the other side, and corn and hay stacks are gnawn through. Like an army of locusts, they pass on, leaving a desolate track behind them; nor do they stop till they reach the sea, where thousands are drowned. During their march great numbers are destroyed by hawks, owls, weasels, &c.; and so great is the havoc thus committed, and by their being swept away in crossing rivers, and by similar casualties, that but few ever reach their native haunts again. The cause of these migrations is not well known, but is supposed to arise from want of food. They appear to take place at irregular intervals; but, upon an average, about once in ten years." In former times, the lemmings were superstitiously regarded by the peasants of the countries they went over, the popular belief being that they fell from the clouds; and in such dread were they held, that it used to be the custom for priests to exorcise them with bell, book, and candle."—*Ref.* Baird's *Cyclopædia of the Natural Sciences.*

LEMNACEÆ. (*See* PISTIACEÆ.)

LEMNIAN EARTH, or SPHRAGIDE, *lem'-ne-ăn*, a species of bole, or kind of earth, found in the island of Lemnos, in the Ægean Sea. Amongst the ancients this substance was celebrated as a sovereign remedy against poisons and the bites of venomous reptiles. It was also much used in medicine, not only as an alexipharmic, but also as an astringent, sudorific, vulnerary, &c. There were three varieties of Lemnian earth,—the white, the red, and the yellow; of which the two former were considered the most valuable. They were brought from the Levant, mostly in the shape of small cakes, bearing the impression of a seal, from which circumstance it gained the name of *terra sigillata*. In external appearances it resembles a clay, with a smooth surface like agate, especially in recent fractures. It is of a fatty consistence, and has a soapy feel, adheres slightly to the tongue, and falls to pieces when immersed in water. When analyzed, it is found to consist of—silica 66, alumina 14·5, soda 3·5, oxide of iron 6, water 8·5, with slight traces of magnesia and lime. Till within the present century, the Turks and Greeks believed that the Lemnian earth was possessed of imaginary virtues. The cups and goblets used by the Sultan and chiefs were invariably made of this substance. The alexipharmic and astringent properties of this and other boles are now held in little or no esteem; but, used in the same manner as soap, it is still used in order to remove impurities.

LEMON, *lem'-on* (Fr. *limon*, Low Lat. *limonium*).—The fruit of the lemon-tree (*Citrus limonum*) was originally brought to this country from the tropical parts of Asia, but is now very extensively cultivated in the south of Europe, and especially in Sicily, where the fruit forms an important article of commerce. The lemon is a variety of the citron, and belongs to the natural family *Aurantiaceæ*. The juice of the lemon makes one of the most popular and refreshing beverages,—lemonade. The fresh rind of the lemon is a gentle tonic, and when dried and grated, is used in flavouring a variety of culinary preparations. Lemons appear in company with the orange in most orange-growing countries. They were only known to the Romans at a very late period, and, at first, were only used to keep the moths from their garments, their acidity being unpleasant to them. In the time of Pliny the lemon was hardly known otherwise than as an excellent counter-poison. At the present time lemon-juice is employed by calico-printers in order to discharge colours.

LEMON.

LEMONADE, *lem'-on-aid* (Fr. *limonade*), is a drink prepared of water, sugar, and the juice of lemons, literally speaking; but cream of tartar forms the principal ingredient of a good deal of the lemonade manufactured in London. It was first publicly sold in England in the years 1630-33, when it was imported from Italy, in which latter country it was first made.

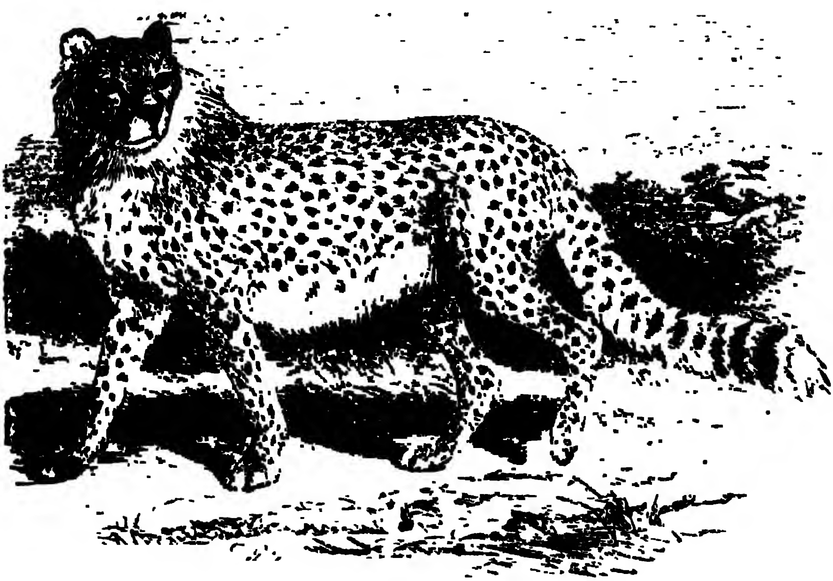
LEMON-GRASS OIL. (*See* ANDROPOGON.)

LEMUR, *le'-mur* (Lat. *lemur*, a ghost), a term formerly applied, in the Linnæan system of zoology, to several of the lower quadrumanous animals of different structure and habits. However, it is now restricted to such as have the inferior incisors long, compressed, and sloping forwards, and the lower canines approximated and of similar form and direction. "Each of the four extremities is provided with an opposable thumb; but the index digit of the hinder hand has its nail developed into a long curved sharp-pointed claw." The lemurs are natives of Madagascar, and of some of the smaller islands in the immediate neighbourhood. Their food is composed of a mixed diet of fruits, insects, and small birds, they being able to surprise the latter while at roost during the night-time. (*See* FLYING LEMUR.)

LEMURES, *lem'-u-reez*, a term applied, in Roman

Plate LXXIX.

AFRICAN LEOPARD.



HUNTING LEOPARD.

antiquity, to the ghostly souls of the dead, that tormented men in the night-time; whence they are also called *nocturnal*, or *black*. A ceremony, called indifferently either *lemuria*, *lemuralia*, or *remuria*, used to be observed on the 9th, 11th, and 13th of May; and was thus celebrated on account of its supposed efficacy in laying the souls of the departed. The ceremony of the lemuralia is thus described in the "Popular Encyclopædia:"—"About midnight, when everybody was asleep, the head of the house arose, and went, barefooted, softly, and in silence, to a fountain; with a snap of the fingers, still keeping silent, he protected himself from the spectres. Having washed his hands at the fountain, he returned, took some black beans in his mouth, and, without looking round, threw them nine times over his head, repeating each time—*Hæc ego mitto; his fabis me meosque redimo* (These I send; with these beans I redeem me and mine). He then washed his hands again, struck a hollow copper vessel, saying nine times, during the operation, in a supplicating tone—*Manes, exite, paterni* (Ye souls of my ancestors, depart). He now looked round, and the ceremony was finished. It was believed that the spirits came and collected the beans."

LENITIVES, *len'-e-tivs* (Lat. *lenis*, gentle), in Med., is applied to purgatives which act in a gentle manner, and have a soothing effect.

LENS, *lenz* (Lat., a small bean), a name given in Optics to a piece of glass, or other transparent medium, bounded on both sides by two spherical surfaces, or on the one side by a spherical and on the other by a plane surface. A lens has the property either of collecting parallel rays of light into a point or focus, or of causing them to diverge, according to the laws of refraction. Lenses vary in form, that is, are terminated by various surfaces, from which they acquire different names. A *spherical lens* is a sphere or globule of glass. A *double convex lens* has both sides convex; a *plano-convex* has one side plane and the other convex. A *double concave lens* has both sides concave; a *plano-concave lens* has one side plane and the other concave. A *meniscus lens* (so called from its resemblance to a little moon) has one side convex and the other concave, both of which meet at the edges; while in the *concavo-convex lens* the sides are parallel, and are joined by a flat surface. Those lenses which are thicker in the middle than the edge cause the rays of light to converge in passing through them; and those which are thicker at the edges than at the middle cause pencils of light which are refracted through them to diverge. From a very early period it was observed that a transparent body of spherical form was able to collect at a point parallel rays of light. It was also remarked that the illumination at these points was feeble, on account of the thickness of the glass which the light had to pass through. By taking two small segments only, instead of the entire sphere, the inconvenience was removed; since the refraction, in the latter case, takes place only at the surfaces, and not in the interior of the glass, the very same refraction of the rays is produced as when the entire sphere is used. In the manufacture of lenses, the spherical surfaces are produced by grinding them in counterpart tools, or discs of metal, prepared to the same curvature as the lenses. The glasses for lenses are first brought to a rough circular form, and afterwards ground and polished with fine emery and putty-powder. The grinding and polishing of the finer varieties of lenses for telescopes, microscopes, and other delicate apparatus, requires extremely nice manipulation.

LENT, *lent* (Lat. *quadragesima*), is a period of forty days observed in the Christian Church in commemoration of our Saviour's fasting in the wilderness. The name is derived from the Saxon *leng*, spring, from the time of the year in which it is observed. It is used as a preparation for Easter, and begins on Ash-Wednesday. The observance of Lent is of great antiquity, for from the first ages of Christianity it was usual to set aside some time for humiliation and special exercises immediately before Easter. At first this fast extended only to forty hours, then to thirty-six days; and four additional days were added in the 9th century. Anciently, the mode of observing Lent was to abstain from food till the evening, the only refreshment being supper, which, however, might include flesh or any other of food; the restrictions as to particular kinds being subsequently introduced. The Church of England has retained the Lent season in its calendar, and has appointed appropriate collects, epistles, and gospels; but it has left to individuals to prescribe for themselves that rule of life which is best fitting to habits of self-denial.

LENTIBULARIACEÆ, *len-te-bu-la-re-ai'-se-e*, in Bot., the Butterwort fam., a small nat. ord. of *Dicotyledones*, sub-class *Corolliflora*, consisting of herbs growing in water, marshes, or wet places. The leaves are radical, entire, or divided into thread-like filaments, bearing little pouches or air-vesicles. The flowers are irregular, with persistent 2-lipped calyx, and a 2-lipped corolla. The species *Pinguicula vulgaris* is termed butterwort, from the property its leaves possess of coagulating milk.

LENTIGO, *len-ti'-go* (Lat.), in Med., is a freckle on the skin; so named from its resemblance to lentil-seeds.

LENTILS. (*See* ERVUM.)

LEO, *le'-o* (Lat. *leo*, the lion), a constellation of the northern hemisphere, which gives its name to the fifth sign of the zodiac. It is situated between the constellations Ursa Major, or the Great Bear, Virgo, and Cancer. The most conspicuous stars in this group are Regulus, or α Leonis, of the first magnitude, and Deneb, or β Leonis, of a magnitude midway between the first and second, which is intersected by a straight line drawn through the polar stars and the star γ in Ursa Major.

LEO MINOR, or the Little Lion, a constellation of the northern hemisphere, formed and named by Helvetius, lying immediately to the south of the Great Bear, and between Lynx, Leo, and Cancer. It is composed of small stars, all of them being less in apparent size than stars of the fourth magnitude.

LEONINE VERSES, *le'-o-nine*, is a species of poetry much in fashion during the middle ages, and consisting of the introduction of rhyme into Latin verse. The term is said to be derived from a poet Leo, or a monk Leoninus. As an instance, is the famous song of Walter de Mapes:—

> "Mihi est propositum in taberna mori;
> Vinum sit appositum morientis ori."

Sometimes the rhymes fall in the same line, the end rhyming to the middle; as—

> "Dæmon languebat, monachus tunc esse volebat;
> Ast ubi convaluit, mansit ut ante fuit."

LEOPARD, *lep'-pard* (*Felis leopardus*), a name applied to the larger spotted cats (*Felidæ*), which are found both in the Old and New worlds. In the continent and islands of the Old World, the leopard appears to have its most perfect development; but the American jaguar far excels the leopards of Asia and Africa in size, strength, and sturdiness of make. There is much discrepancy of opinion among naturalists as to whether the leopard and panther (*Felis pardus*) are distinct species or only varieties. Cuvier separated the panther from the leopard specifically. He describes the panther as being yellow above and white beneath, with six or seven rows of black spots, formed by a cluster of five or six simple spots on each side. He speaks of the species as being found all over Africa, in the warm countries of Asia, and in the Indian Archipelago. The leopard is referred to as differing from the panther in having ten rows of smaller spots. Linnæus, however, could not see sufficient grounds of distinction between them, and referred both names to one and the same animal (*Felis leopardus*). The leopard properly so called is a beautiful but savage animal, and is spread over the African continent as widely as the lion. Over this vast extent he varies little, and that merely in magnitude and in the size and form of his markings and their depth of colour. Everywhere, however, he is the same in respect to form and structure, disposition and character. The general colour of the leopard is yellowish fawn, which grows paler in the sides till it merges into the white of the under part of body. Over the head, neck, back, and limbs are scattered black spots of various sizes; while the sides are covered with numerous rose-shaped spots. The leopard's general aspect is fierce, and its disposition is characterized by all the fierceness and craftiness which

RING-TAILED LEMUR.

MOROCCO LEOPARD.

is noticed in the rest of the cat tribe. He preys upon antelopes, monkeys, and the smaller quadrupeds; but avoids man except when closely pursued, when he fights obstinately. Leopards have been known to attack solitary travellers. When they fall in with a flock of sheep, they commit almost incredible slaughter. Two leopards, a male and female, with three young ones, have been known to enter a sheepfold near the Cape of Good Hope, when the old animals killed nearly a hundred sheep. After having gorged themselves, they fed their young, and each seizing a whole carcass tried to carry it away; they were waylaid, however, and killed. The mode by which the negroes capture the leopard is by digging pitfalls and slightly covering them with hurdles, over which a piece of meat is laid as a bait. From the great flexibility of the limbs of this animal, he is able to ascend trees with great ease, and when pursued, is in the habit of taking refuge among the branches. He can be somewhat tamed when taken very young. According to the accounts of African travellers, the flesh of the leopard is excellent, resembling veal in flavour. The skins are valuable for making rugs, &c., and are sold in Europe at from £5 to £10. Among the larger spotted cats of the Old World is the rimau-dahan, which partakes, in some measure, of the markings of the tiger and leopard, though it seems to be more allied to the former than to the latter. Its probable size, when full-grown, will be about four feet from the nose to the root of the tail; and its height, at the shoulder, about one foot ten inches. Its colour is brownish grey, with no yellow or red tints. Its spots and stripes are large, dark, irregular, and oblong in form; the larger ones being marked by lines of velvety black. It inhabits Sumatra. According to Sir Stamford Raffles, who made personal observations on two individuals of the species, while young, these leopards are very gentle and playful. He brought one specimen alive to England; but it died shortly after its arrival, during the process of dentition "On board the ship," he relates, "there was a small Musi dog, who used to play round the cage and with the animal, and it was amusing to observe the playfulness and tenderness with which the latter came in contact with his inferior-sized companion." This specimen was taken very young in the forests of Bencoolen. The natives assert that the rimau-dahan never attacks man, but lives principally upon poultry, birds, and the smaller kinds of deer; and that it sleeps, and often lays in wait for its prey, on trees; from whence it derives the name of *dahan*, which signifies the fork formed by the branch of a tree. One of the most interesting forms of division of the *Felidæ* is the chetah, or hunting leopard (*Cynailurus jubatus*); it is inferior in size to the leopard proper, not being more than thirty-two inches high; besides which, his limbs are not so graceful nor his fur so sleek as the majority of the cat tribe. The claws of the chetah are not retractile, or, at most, so slightly that naturalists have found a difficulty in agreeing as to the animal's genus. The chetah is of much lighter build than the panther, shows better fight when hunted with dogs, and commonly inhabits the lower branches of the great trees of the forest, where the female brings forth her young. It is common with the European inhabitants of Ceylon to style the leopard there found, chetah; but the true breed of hunting-leopard does not there exist. Whether the chetah is taken as a cub and trained to the business of deer-hunting, or whether, as a full-grown animal, it may be trapped and broken in, does not seem clear; it would, however, seem most probable that the former system was adopted; for although we have instances of leopards and panthers becoming so far docile as to tolerate the society of man, it requires the utmost care that they do not relapse to their naturally ferocious habits. When the trained chetah is required for a day's sport, he is placed in a sort of cart, drawn by a horse, and accompanied by the hunters and the usual company that belong to the chase in India When an antelope is started, it is shown to the chetah in the tumbril, who, as soon as his leash is slipped, leaps after it. The speed of the deer is much greater than that of the chetah; but it invariably happens, that as soon as the former becomes aware of its terrible pursuer, it becomes panic-stricken, and its swift and regular paces change to spasmodic leaping and stumbling, while the chetah, eager for the sanguinary reward for his service, increases his speed, and is presently on the back of the struggling animal, with its fangs buried in its throat. The hunters hasten up with the chetah's hood and chain, and after he has been enticed from the deer by the offer of pieces of meat, the hood is slipped over his eyes, and he is led back to the tumbril and held till fresh game is started. The behaviour of the chetah in confinement is that of an ordinary savage dog. The chetah in its external form and habits presents a mixture of the feline and canine tribes; from whence it derives its name of *Cynailurus*, from the Greek *kunos*, a dog. The jaguar (*Felis Onca*), or American panther, is the form which the leopard takes in the New World. (*See* JAGUAR.)

LEOPOLDINIA, *le-o-pold-in'-e-ă* (so named after the empress of Brazil), in Bot., a gen. of Palms. *L. Piassaba* is a very interesting and useful plant. Its persistent petiole-bases terminate in long pendulous beards of bristle-like fibres: these are cut off from the young plants after having been previously combed out by means of a rude comb, and now form an important article of commerce in Brazil. These fibres are known under the names of Piassaba or Piaçava, para-grass and monkey-grass, and are used for brooms, cleaning-brushes, &c. The pulpy envelope of the fruit yields a delicious drink resembling cream.

LEPIDOLITE, *lep'-e-do-lite* (Gr. *lepis*, a scale; *lithos*, stone), in Min., a mica containing lithia, rubidia, and cæsia. It is generally employed as the source of these rare alkalies.

LEPIDOPTERA, *lep-e-dop'-ter-ă* (Gr. *lepis*, a scale; *pteron*, a wing), an order of insects which contains those generally known by the name of butterflies and moths. They have four membranous wings, covered on both sides with minute generally coloured scales, which appear to the naked eye like a quantity of fine dust scattered over them. They possess also a long proboscis, or trunk, rolled up spirally; and two antennæ, generally long, of variable form. The Lepidoptera undergo perfect metamorphosis. In general, the females are rather larger than the males, and their colour less brilliant In the *imago* state they are very short-lived; the males die shortly after the act of generation is accomplished, and the female soon after she deposits her eggs. The nectar of flowers forms their principal food, and they suck it up from the depths of the narrowest blossoms by means of their proboscis, which is wonderfully adapted for the purpose. The females of different species lay their eggs upon different plants, according to the proper food required for the young caterpillar. Thousands of eggs are sometimes laid by one insect, and they are made to adhere to the surface of the leaf on which they are deposited. The larvæ of the Lepidoptera are well known by the name of caterpillar. When ready to be hatched, they come out in a worm-like form, the body being cylindrical and composed of thirteen segments. They have three pairs of simple articulated feet, which serve the purpose of walking; and from two to five pairs of false legs, short and thick, armed at the end with hooks, which enable the animal to fasten itself on leaves, branches, &c. Most of these larvæ move forwards, but some walk backwards, with a sort of leaping motion; while others draw the body into a loop-form, then suddenly straightening, spring forwards with an energetic bound. During this state of their existence, they do considerable damage to trees, shrubs, &c., and change their skin several times. They then cease feeding, and change into the chrysalis or pupa state. (*See* INSECT-TRANSFORMATIONS.) When the perfect insect emerges, the wings are at first moist and unexpanded; it then appears weak; but, soon after being exposed to the air, its wings become dry and expand, and the insect seems full of life and activity. There are supposed to be about 12,000 species of Lepidoptera, or nearly one-sixth of all the insect tribes. More than 2,000 are said to be natives of Britain. They present many points of interest to the entomologist, especially in their larva and their pupa state; while the beauty and elegance of the forms of the perfect insects are admired by all. The value of the silk cocoons of the pupæ of certain species is almost equal to the damage done by the larvæ of others. The Lepidoptera have been divided into three large classes: the *Diurna*, or

those which fly by day; the *Crepuscularia*, or those which fly in the evening; and the *Nocturna*, or those which fly by night. Many of the Nocturna, however, fly by day, and *vice versâ*; in consequence of which another arrangement has been adopted, based upon the construction of the antennæ. In the butterflies, the antennæ are always club-shaped at the extremity; they are, therefore, classed in the group *Rhopalocera*, club-horned. The moths, on the contrary, never have the antennæ with club-shaped ends; they are generally cetaceous, filiform, fusiform, or pectinated; they have been, consequently, classed in the group *Heterocera* varied-horned.

Lepidosiren, *lep'-e-do-si'-ren* (Gr. *lepis*, a scale), the Mud-eel, an animal which in late years has given rise to much discussion among naturalists, as to whether it belongs to the class of reptiles or fishes. It is one of the most perfectly amphibious of all animals. Its organs of respiration are twofold. As in all fishes, it has well-organized gills on the inner edge of the branchial arches, and a regular gill-cover, with a small oblong aperture in front of the base of the anterior members. Besides these, it has two well-developed cellular lungs of nearly equal size. The body is elongate and fish-like in form, covered with oval imbricated scales, and furnished with dorsal and caudal membranes resembling fins, strengthened with soft-jointed rays. According to the supporters of the reptilian theory, these members are feet; while those who regard the animal as a fish look upon them as fins. Two species of Lepidosiren are known,—the *L. paradoxa* and the *L. annectans*: the former is found in the Amazon and the latter in the Gambia. Several living specimens of the animal found in the Gambia have been brought to this country. During the inundations of the river, large portions of country are flooded; upon the retreat of the waters, the lepidosirens that are left behind burrow into the mud. The sun soon converts this into a hard cake, and they remain cased up in a sort of cocoon of dried mud. They remain torpid, and covered with a thick secretion of mucus, till the rainy season again commences, and the flooded river releases them. A short time ago, several of these animals were brought over to this country in their hard cocoons, and afterwards exhibited alive at the Crystal Palace at Sydenham. The natives eat the lepidosirens, and it is said that, when fried, they closely resemble eels in taste, and have a rich oily flavour.

Lepidum, *lep'-e-dum* (from Gr. *lepis*, a scale), in Bot., a gen. of the nat. ord. *Cruciferæ*. *L. sativum* is the garden cress, well known as a pungent salad, being commonly used with the young herb of the mustard-plant. (*See* Sinapis.)

Lepra, or **Leprosy**, *lep'-ra lep'-ro-se* (Gr. *lepra*, scaliness), in Med., is a disease characterized by the formation of scaly patches on the skin, of different sizes, but having always nearly a circular form. Physicians distinguish three varieties of this disease,—*Lepra vulgaris*, or common leprosy; *Lepra alphos*, or white leprosy; and *Lepra nigricans*, or black leprosy. Leprosy first manifests itself in small distinct reddish elevations of the cuticle, which enlarge till they sometimes attain the size of a crown-piece. They are covered with scales, which accumulate and form a thick prominent crust, and are quickly reproduced as they fall off. This disease usually makes its appearance first about the knee or elbow, and extends by degrees along the extremities, till sometimes the whole body becomes affected by it. Its progress is, in general, very slow, and it may continue in the same state for years. The general health of the patient is but little disturbed by this disease. In lepra alphos the scaly patches are smaller than in lepra vulgaris, and have also their central parts depressed or indented. The lepra nigricans differs from the others chiefly in the colour of the patches, which are dark and livid. This disease sometimes makes its appearance without any apparent cause, sometimes it may be induced by exposure to cold or damp, and sometimes it is evidently hereditary. It is generally tedious of cure. The diet should be light and moderate, and all heating and stimulating liquors avoided. Externally, warm baths, sulphur-baths, and preparations of tar or creosote, are useful. The constitutional treatment will depend upon the condition of body; if weakly, tonics, as quinine and iron, are to be administered. A solution of arsenic is often of advantage; but, of course, it can only be used under medical superintendence. This disease appears to have been much more prevalent, and of a severer type, in ancient than in modern times, if indeed this is the same disease,—many being of opinion that the leprosy of ancient times resembled rather what is now known as elephantiasis. (*See* Elephantiasis.)

Leptospermeæ, *lep-to-sper'-me-e* (Gr. *leptos*, slender; *sperma*, a seed), in Bot., a tribe of the nat. ord. *Myrtaceæ*, characterized by having capsular fruit. The typical gen. is *Leptospermum*, two species of which, *L. scoparium* and *thea*, have leaves which are used in the Australian colonies as a substitute for tea.

Lepus. (*See* Hare.)

Lepus, *le'-pus* (Lat. *lepus*, the hare), one of the original constellations of Aratus and Ptolemy, situated in the northern hemisphere, to the south of Orion. Its most considerable stars are of the third and fourth magnitude.

Le Roi (or la Reine) le veut, *le(r) rwaw (la raine) le(r) vuh(r)*, (Fr., the king, or queen, wills it), is the form in which the royal assent is given to the passing of public bills in parliament. (*See* Assent, Royal.)

Lesion, *le'-zhe-on* (Lat. *lædo*, I hurt), in Surg., is a term used to denote any kind of wound or bodily injury.

Lessons, *les'-sunz* (Lat. *lego*, I read), are certain portions of Scripture read in church during Divine service. The reading of the holy Scriptures formed an important part of public worship from the earliest ages of the Church. It seems to have been late, however, before any systematic table of lessons was prepared, though certain parts of Scripture appear to have been read at certain periods of the year; as the account of our Lord's resurrection during Easter. In the Church of England, the course of lessons begins, at the beginning of the year, with Genesis, and continues till the books of the Old Testament, and also portions of the Apocrypha, are read over, with the exception of the books of Chronicles, and such chapters in the other books as are less profitable to ordinary readers. The book of Isaiah is reserved for the end of the year, near to Christmas. The second lessons are taken in regular course from the New Testament; those for the morning service from the gospels and the Acts of the Apostles; those for evening service from the epistles. In the Presbyterian churches, the word lesson is not used in this sense, and the portions of Scripture which are read at public worship are selected for the occasion by the officiating clergyman.

Lethargy, *leth'-ar-je* (Gr. *lethe*, forgetfulness; *argia*, inactivity), is a state of unnaturally prolonged and continuous sleep. It is intermediate between heavy sleep and a state of complete coma, and may result from severe exertion of the body or mind; but it is also frequently produced by congestion of blood in the vessels of the brain; and hence it is often a symptom of great danger, frequently preceding an attack of apoplexy. It may also be caused by the action of any narcotic substance, or of alcoholic liquors. In general, the cure is effected by the removal of the cause by which it has been brought about. If the result of a determination of blood to the head, then topical bleedings by cupping, and purgatives, are required; but if, on the other hand, it proceed from nervous weakness, then tonics, stimulants, and a generous diet are necessary. (*See* Apoplexy, Coma.)

Letter of Credit, is an order given by a banker, or other person, at one place, to his agent in another, authorizing him to pay to a particular individual a certain sum of money. A letter of credit is not a negotiable instrument, and therefore only the person named in it can legally demand payment.

Letter or Power of Attorney, is a letter or instrument by which one person authorizes another to do some act for him, such as to sign a deed, collect rents, &c., the party so authorized to act being called the attorney of the other. The terms of the letter must be strictly adhered to, for the principal is only bound for the acts of his agent to the extent that he authorized him to act. It includes, however, an authority to do everything that is absolutely necessary in

carrying out the orders of the letter. The authority to act ceases on the death of the person granting it.

LETTERS, *let'-terz* (Ang.-Nor.), are those marks, signs, or characters, painted, engraved, or printed, used as the representatives of sound, or of an articulation of the human organs of speech; thus representing ideas by phonetic signs. Letters form the elements of written language, just as simple sounds constitute the elements of spoken language, or speech. Sounds communicate ideas through the agency of the ear; letters forming the visible representatives of sounds, communicate thoughts by means of the eye. (*See* ALPHABET, PHILOLOGY, WRITING.)

LETTERS OF MARQUE. (*See* MARQUE, LETTERS OF.)

LETTERS PATENT (Lat. *literæ patentes*, open letters), are letters of the queen, conferring some honour or privilege upon a party, and are so called because they are not sealed up, but exposed to view, with the great seal pendent at the bottom, and are usually directed or addressed by the queen to her subjects at large. They thus differ from certain other letters of the queen (*literæ clausæ*), which are directed to particular persons; and not being for public inspection, are closed up and sealed on the outside. Queen's grants, whether of lands, honours, liberties, franchises, or anything else that can be granted, are contained in charters or letters patent. The old mode of obtaining grants has been abolished by statute 14 & 15 Vict. c. 82, which provides that, in every case where any gift, grant, or writing whatsoever, to be passed under the great seal, would have required a queen's bill or bills from the offices of the signet and privy seal, her majesty may, by warrant under the royal sign manual, addressed to the lord chancellor, command him to cause letters patent to be passed under the great seal, according to such warrant, and that such warrant shall be prepared by the attorney or solicitor-general, and shall set forth the proposed letters patent, and be countersigned by one of the principal secretaries of state, and sealed with the privy seal. The granting of letters patent for an invention is specially regulated by 15 & 16 Vict. 83. (*See* PATENT.)

LETTER-WRITING is a branch of literature which, unfortunately, is but little studied. It is to be regretted that more pains are not taken to excel in an art which is so commonly and so universally practised. There are comparatively few persons that can write a good letter; and yet it is an attainment that may be reached by comparatively little pains and study. A good letter requires to be easy, natural, and well expressed, suited to the circumstances, and to the character of the person to whom it is addressed. The French, from being more natural, and having the power of expressing their feelings more vividly, greatly excel us in this line, and published collections of letters form a considerable branch of their literature. Among the more celebrated published letters of this country are those of Sir William Temple, Addison, Pope, Swift, Bolingbroke, Lady Montague, Chesterfield, Gray, and Cowper.

LETTRES DE CACHET. (*See* CACHET.)

LETTUCE, *let'-tus* (Fr. *laitue*), a smooth, herbaceous, annual plant, containing a milky juice, which has been cultivated from very early times. It is much used as a salad. There are many varieties of cultivated lettuces, which are divided into two families,—the cos and the cabbage. The cos varieties are distinguished by being of an upright growth, and are more grown in summer than winter. The cabbage lettuce is grown at all seasons, but more especially in winter, on account of its superior hardihood. It grows close to the ground, and produces a blanched heart, like the cabbage, without assistance. When young, the cabbage varieties are generally sweeter than those of the cos at the same age, but at full growth this is reversed; hence the latter are preferred for salads, and the former for soups. (*See* LACTUCA.)

LETTUCE.

LEUANILINE, *lu-an'-e-leen*, in Chem., a base obtained from aniline by acting on a salt of rosaniline with sulphide of ammonium. It is a dazzlingly white crystalline solid, soluble in water, and forming well-defined salts with the acids. It differs from rosaniline in containing two equivalents of hydrogen less than that alkaloid; in other words, leuaniline seems to bear the same relation to rosaniline that white indigo does to the blue variety.

LEUCINE, *lu'-sine*, in Chem., a substance formed during the decomposition of cheese, muscle, or gluten, in the presence of water. It forms crystalline salts with several of the acids. It is somewhat cholesterine in appearance. It is sparingly soluble in cold water, but readily so in hot. It has an unctuous feel, and sublimes at 340° in woolly flocculi.

LEUCOMA, *lu-ko'-ma* (Gr. *leukos*, white), in Med., is applied to a white opacity of the cornea of the eye. It is occasioned by acute inflammation, causing a deposition of lymph either upon the surface or into the substance of the cornea. When merely superficial, it often passes away with the cessation of the inflammation, but when deep seated it is often incurable. Astringent lotions are generally recommended.

LEUCOPETRIANS, *lu-ko-pet'-re-anz*, in Eccl. Hist., is the name of a fanatical sect of Christians which sprang up in the Eastern Church towards the close of the 12th century. Their founder was Leucopetrus, and his chief disciple Tychicus. They asserted that there dwelt in every individual an evil genius, which could only be expelled by continued prayer and supplication, in which alone they believed religious service to consist; and hence they rejected all external forms of worship. They professed to believe in a double Trinity, rejected marriage, abstained from flesh, and treated the sacraments with contempt. They disappear from history after the death of their leaders.

LEUCOPOGON. (*See* EPACRIDACEÆ.)

LEVARI FACIAS, *le-vai're fas'-she-as*, in Law, is a writ of execution directed to the sheriff, commanding him to levy the plaintiff's debt on the lands and goods of the defendant. By it the sheriff may seize all the defendant's goods, and receive the rents and profits of his lands till satisfaction be made to the plaintiff. This writ is now little used, the remedy by elegit, which takes possession of the lands themselves, being much more effectual.

LEVATOR, *le-vai'-tor* (Lat. *levo*, I lift up), in Anat., is a name given to certain muscles which serve the purpose of lifting the parts to which they are attached.

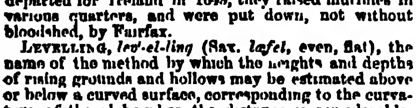
LEVEE, *lev'-e* (Fr. *lever*, to rise), properly denotes the time of rising, and is commonly applied to the visits which princes and other distinguished personages receive in the morning. It is specially applied in this country to the stated public occasions on which the sovereign receives visits from persons of rank or fortune. A levee differs from a drawing-room only in that ladies are admitted to the latter but not to the former.

LEVÉE EN MASSE (Fr., universal rising), a military term applied to the rising of a whole people in arms; including all those capable of bearing them that are not actually engaged in the regular service. The volunteer movement in England would produce a *levée en masse* in case any invasion should threaten us. A writer in the "Popular Encyclopædia" ably remarks on the movement in the following words:—"When animated by patriotic feelings, it is the most formidable obstacle an enemy can encounter; and it is unconquerable if favoured by the nature of the ground, because almost every advantage is on the side of the people. They fight on their own soil; they know the ground; they find support and assistance in every house, from every woman and child; they fight for their own hearths; they inclose the enemy on all sides, and can destroy whatever can be useful to him, cut off his communications, pursue, annoy, disturb, assail, harass him incessant' that he can effect nothing, except getting possession of the strong places. It is called *landsturm* in Germany, meaning *land storm*, in distinction to the militia, or *landwehr*. This distinction was first made in 1796, when the peasants of Bavaria and Franconia fell upon the rear of the flying French under Jourdan with much success. The *landsturm* was yet more effective in 1799, and in 1813 the governments of Northern Germany called it forth in every part of the country. It consisted of every male person

capable of bearing arms of any sort, whom age or other reasons exempted from the militia service. Orders were issued to turn anything into weapons, to defend the country by every means, and to injure the enemy in all possible ways, by destroying provisions and wells, attacking stragglers, intercepting couriers, and escorting prisoners. The *landsturm* was useful also at the siege of several fortresses. Its organization was founded on municipal decisions. Napoleon ordered the *levée en masse* when the allies entered France, and it threatened to become dangerous to them; but the capture of Paris put an end to the war. The last trace of the kind may be said to have taken place in Poland. The chief differences between a *levée en masse* and militia may be stated, in conclusion, to be, that in the former all persons are comprised that are not included in the latter; that they do not march from home; and that their service is more irregular, and even owes its strength to that very irregularity.

LEVELLERS, *lev'-el-lerz*, in Eng Hist., is the name of a party which arose in the army of the Long Parliament, and whose professed object was to level all ranks of society, and to establish equality in titles and estates throughout the country. When Cromwell departed for Ireland in 1649, they raised mutinies in various quarters, and were put down, not without bloodshed, by Fairfax.

LEVELLING, *lev'-el-ling* (Sax. *læfel*, even, flat), the name of the method by which the heights and depths of rising grounds and hollows may be estimated above or below a curved surface, corresponding to the curvature of the globe when the distance is considerable, or above or below an horizontal plane passing through a certain point in the earth's surface when the distance is short. In geodetic surveys, where the operations extend over a great part of the earth's surface, great nicety is required, and the measurements must be made with reference to the actual spheroidal shape of the earth; but in levelling a piece of ground for a railway or canal, it is sufficient to consider the surface to which the measurements are referred as being perfectly spherical. If it be desired to find the heights of a successive series of points in a line, straight or curved, running along the surface of the earth, it is manifest that the heights of these points can only be determined by referring them to other points, which are called level-points, and which are themselves equidistant from the centre of the earth, its form being assumed to be spherical. Such points are found by the aid of a spirit-level and by an instrument called a theodolite. (*See* THEODOLITE.) Suppose that it is desired to determine the relative heights of the points



A, B, C, D, along the surface of the ground, in a line proceeding direct from A to D. When the most convenient stations have been determined at intervals along the line between its extremities, which in the present instance are assumed to be at B and C, and the distances between them have been ascertained by measurement, the operator proceeds to place the theodolite midway between the first and second stations A and B, and, by the aid of the spirit-level, brings the telescope into such a position that the line passing through the centres of its lenses (called the line of collimation) may remain perfectly parallel to the plane of the horizon when the instrument is turned about its vertical axis. All points, therefore, at distances be ..., which would be intersected by the line of collimation produced, would be level-points, since they are in a plane passing through that line, provided always that they are equidistant from the vertical axis of the telescope, and if any two points in a straight line with each other and the axis of the instrument be determined, the relative heights of any points above or below these may be readily ascertained. The surveyor having brought his instrument into a position parallel to the horizon at a point midway between the stations A and B, looks towards the station-staff at A and gives signals to the assistant standing there, to move the index up or down the staff as may be requisite, until it comes directly in the plane in which the line of collimation lies, which is ascertained by means of the coincidence of the point in question with the point of section of two wires, fixed within the telescope at right angles to each other, in the line of collimation, and crossing in the centre of the field of view. Turning the telescope towards the station at B, he goes through the same operation, and as the staves are divided into feet and inches, the distance between the index and the surface of the ground at each station is known, and the relative heights of the points A and B are determined; the difference between the numbers shown on each staff denoting the number of inches that the point B happens to be below the point A. As the heights are successively taken from positions midway between each pair of stations, they are registered in a field-book, the heights Bx, Cy, Dz, being entered in one column as fore-sights, while the heights Ap, Bq, Cr, are entered in another as back-sights. By the aid of these heights, and a table of the distances between each station, an accurate sketch of the profile of the ground along the whole extent of the line can be made according to scale, the distances between the stations being drawn on a less scale than the heights, for the sake of clearness, as they are so very long in proportion to the extent of the heights. This enables the engineer to regulate the extent of the embankments and cuttings that must be made in the construction of a railway or canal along the line that has been thus determined by levelling. The method employed in measuring a base-line for a trigonometrical survey of a country may be ascertained from the works to which reference is made at the end of the article on GEOLOGY.—Ref. *English Cyclopædia*—Arts and Sciences.

LEVER, *le'-ver* (Lat *levo*, I lift up), in Mech., an inflexible right line, rod, or beam, movable about a fulcrum or prop, and used for the raising of weights, being either without weight itself, or at least having such a weight as may be conveniently counterbalanced. The lever is the first of the mechanical powers, and on account of its simplicity was the first that was attempted to be explained. Its properties are treated of by Aristotle, and also by Archimedes. The forces applied to the lever are distinguished by different names,—the *power* and the *weight*. There are three kinds of levers, the difference between which depends upon the relative positions of the power and the weight. In a lever of the first kind, the fulcrum is between the power and the weight. Instances of this kind are to be seen in the crowbar, the handspike, the poker, scissors, nippers, &c. In a lever of the second kind, the weight is between the fulcrum and the power. Examples of this order are to be seen in the oars of a boat, nut-crackers, the common door, the wheelbarrow, &c. In a lever of the third kind the power is between the fulcrum and the weight, as in sheep-shears, the treddle of a turning-lathe, tongs, &c. The bones of animals are principally levers of the third kind. The socket of the bone forms the fulcrum; a strong muscle attached to it near the socket is the power; and the weight of the limb, together with the resistance opposed to its motion, the weight. Thus considerable motion is given to the limb by a very moderate action of the muscle. Of all the mechanical powers, the lever is the most simple. It is formed of any strong substance, in the shape of a beam or rod, which rests on a prop or axis called a fulcrum, which is its centre of motion. There are three kinds of levers. The following is an exemplification of the *first* kind (fig. 1):—In this diagram, *l* is the lever, *f* the fulcrum, *w* the weight. By pressing down at the end *l*, the other end of the lever raises *w*, the weight; the centre of motion is at *f*, the fulcrum. In other words the power or force resting on the prop or fulcrum overcomes the weight or resistance. Thus, if the end of the lever be under the centre of gravity of the weight, and the length of the lever from the fulcrum be twice as long as the other part, a man can raise the weight one inch for every two inches he depresses the end of the outer extremity of the lever. Now, if the end of the lever be four times the length of the part from the fulcrum to the centre

of gravity of the weight, then the power of raising the weight is increased four times; but the space that the *l* end of the lever will pass through is four times greater. It will thus be perceived, that if a weight of one stone moves through a space of ten feet, we may raise a weight of ten stone through a space of one foot; or a weight of ten stone moving through a space of one foot will make a weight of one stone move through a space of ten feet. Now, if a man can raise the weight at the end of the lever,

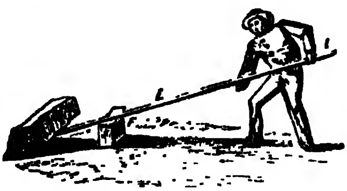


Fig 1

and then the lever be made twice as long, and a boy of half the man's strength can then raise it, the boy will be sooner worn out by fatigue than the man, because the man in the exertion of his strength only goes through half the space that the boy has to pass through. It is stated that "The force of the lever increases in proportion as the distance of the power from the fulcrum increases, and diminishes in proportion as the distance of the weight from the fulcrum increases." It was from this general law that Archimedes exclaimed, "Give me a lever long enough, and a prop strong enough, and with my own weight I will move the world." This was true; but, from the immense parts of a circle his lever would have had to describe, if at the rate of 10,000 feet an hour for about eight hours a day, it would have taken him nearly nine billions of centuries to raise the earth an inch. If a lever, either formed as a scale-beam or having a fulcrum underneath, have a length from the fulcrum of six inches, and a weight upon it of 100 lb., and it be desired to know what length of lever would counterbalance this, multiply the weight by the distance from the fulcrum, when the result will be 600, calculate the weight, 100 lb., as inches, and make the other end of the lever this length, having upon it 6 lb. weight, for 6 lb. multiplied by 100 inches is equal to the other result, 600, the weight and power balancing. Should it be desired to know what power will balance a certain weight at the short end of the lever, it is done by multiplying the weight by the length of lever from it to the fulcrum, and then dividing the result by the other length of lever, and the result is the power required. Thus, if 100 lb. be on one end of a lever 12 inches from the fulcrum, 100 × 12 = 1200; then suppose the long end of the lever be 24 inches, 1200 ÷ 24 = 50 lb., the power required. A *spade* is a lever, the earth being a fulcrum, in the operation of digging. In Ireland they make it a long lever in comparison to that used in England, and thus a man stands upright when digging, with the tails of his greatcoat tucked up behind him. The fisher-girls who dig for worms as bait in the sands on our coast also use a long-handled spade; this is to compensate for manual strength. In moving barrels and very large weights, and principally on board of ships, a *handspike* is the lever found best adapted to the purposes required. Carpenters, masons, and others who have to move bulky masses of matter short distances, adopt the use of a *crowbar*, which is a lever made of iron, having a claw at one end. A hammer has usually a claw for drawing out nails. Now in this the power seems great, for the nail will bear an immense weight attached to it; yet, because we move the hand through several inches while the nail moves only a very short way, we can draw it out, and thus the velocity overcomes the resistance. The *fire-poker* is a lever, having the bar of the grate for a fulcrum. The simple lever has sometimes two arms; it is then called a double lever. *Scissors* are of this kind, having the rivet as a fulcrum for both. Large scissors, called *shears*, used in cutting cloth, pasteboard, tin, copper, and sheets of iron, are double levers. *Nippers, pincers, forceps, snuffers*, are all of this description of levers. The *scale-beam* used in weighing is a simple lever. The arms, *a a*, fig. 2, on each side are made of equal length, and suspended over the centre of gravity. The axis or pivot *b*, which is the point of suspension, is sharpened to a very thin edge, sometimes equal to that of a razor, that the beam may easily turn with as little friction as possible when weights are applied in the scales. Should the arms not be of equal length, then the scales cannot act justly, although the beam may seem fairly balanced and the weights true; but if one were half an inch longer than another in an arm of eight inches in length, the customer would lose an ounce in every pound. The deceit can be discovered by changing the weight and material to the opposite scales. In some cases where the beams of scales are not accurate, the articles to be weighed are put in and balanced by shot, sand, or other things; the things of which it is desired to know the weight are then removed, and weights put in their place: thus the true and exact weight is known. By this mode almost any elastic substance may answer the purpose of a weighing-beam. Suppose a piece of steel, or a walking-stick that will bend, were held over a place, and a substance attached to its end; then, when so attached, mark exactly the place the stick or steel bent to when the substance was on it; remove the thing to be weighed, and attach weights until the steel or stick bends again to the mark, and then the weight of the material is truly found. The Chinese

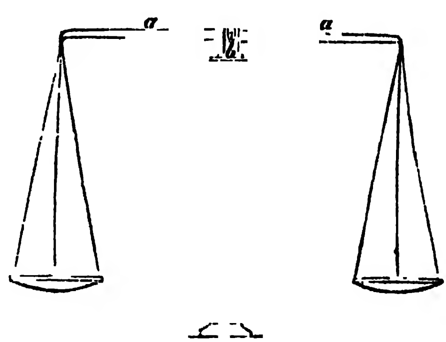


Fig. 2.

and Romans use, instead of the weighing-beam, an instrument called a *steelyard* (fig. 3), which is a lever with arms of unequal length. The lever is suspended from a hook *a*, which is the fulcrum or pivot, and from which the steelyard must truly balance: this is its centre of gravity. Thus, one-pound weight will weigh any number of pounds in the scale that the yard is long enough to perform. In the diagram, the one-pound weight at *c* is weighing eight pounds in the scale at *b*, for the space over which it is placed on the long arm of the lever is eight times that where the scale hangs from on the short arm. By dividing the spaces in the long arm into halves, quarters, and sixteenths, then half-pounds, quarters, and ounces can be weighed. In applying the rule for calculation previously given to the steelyard, it will be found as stated; thus, the short arm is 1, and the weight or resistance in the scale is 8; then 8 multiplied by 1 is equal to 8; the length of the long lever from the

fulcrum is 8, and the weight 1; 8 multiplied by 1 is equal to 8; thus both are in equilibrium. We may here notice the Danish balance, which is a modification of the steelyard (fig. 4). In this construction the weight *a* is permanently at one end, the article to be weighed suspended from a hook at the other end; while

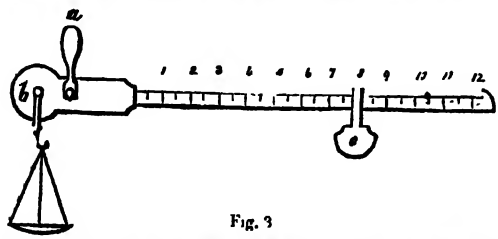


Fig. 3

the handle for supporting the balance, and which forms the fulcrum, is placed at a point somewhere between these. As may be noticed, the gradations are not at equal distances, as in the steelyard. This is owing so the fact that the centre of grav.ty of the beam is constantly changing. Thus, suppose the centre of gravity is at *b*, and the fulcrum placed there, the beam will be perfectly balanced; but if a weight, or an article to be weighed, is placed at *c*, the centre of gravity will be shifted nearer to the weight, say to *d*; the fulcrum then must be moved to the same point. At each change, then, of the weight of the article at *c*, the centre of gravity being moved and also the fulcrum, there is a difference made in the length of the respective levers; moreover, the weight of the portion of the lever from *d* to *b* is transferred from one side to the other. The best way to graduate this balance is to place certain definite weights on the hook *c*, and mark the place where the beam is balanced. An equally-made spring

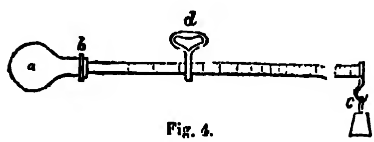


Fig. 4.

is sometimes used as a measure of weight, from its compactness; the letter-balances, now so common, are a familiar example. The annexed diagram (fig 5) represents a spring balance; a cylindrical case *b b*, of iron has one end filled up by a tightly-screwed cover, to which the hook or ring *a* is fastened, by which the balance is suspended. The spring coils spirally round the spindle *c c*, which is securely fastened to a circular plate *e e*, which moves in the inside of the case *b b* somewhat like a piston. The lower end of the spindle *c c* has a hook, to which the dish *d* is suspended, or, instead of the dish, the article to be weighed may pass over the hook. On the hook being pulled downwards, the balance being suspended by *a*, the spindle also pulls the piston *e e*, and consequently depresses the spring in proportion to the force employed The spindle is divided into graduated spaces near the extremity of the case at *f*: according as these are seen out of the case, so is the weight of the article indicated The elastic force of a spring, not being affected by terrestrial gravitation, is that which is used to ascertain the amount of the earth's attraction in various places. The spring has a weight attached to it, and is made to swing clear of the bottom of the machine; weights are then added until the weight just grazes the bottom of the stand. The machine is then carefully packed away, and removed to the place where required, and the difference of the weights there necessary is the difference of the gravity. This is a most delicate instrument, and, from its truthfulness of action in all latitudes, shows the difference of weight or heaviness in all parts of the earth's surface. *The second kind of lever* is that where the weight and the power are on the same side of the fulcrum, the weight being placed between the power and the fulcrum. Thus, if a mason (fig. 6) desire to move forward a large piece of stone, instead of bearing down upon the lever to raise it up a little, he sticks his crowbar into the ground, and pushing upward, moves the stone little by little onward, the ground being the fulcrum. A wheelbarrow affords another example: in using it, a point in the wheel of the barrow pressing on the ground is the fulcrum; the load is the weight, and the handles held by the man the power: as the person shortens or lengthens his hold on the handles, so does he move the centre of gravity to the wheel or himself. If two men carry a load along from a pole resting on their shoulders, and the load be in the middle between them, they have an equal share of the weight; but in proportion as it is more towards one than the other, so is the extra amount of weight to the one nearest to it. The men are the fulcra in this case; they act in that capacity the one to another, while both are the moving power. Should the pole be eight feet long, and the weight 200 lb., placed in the centre, each man will bear 100 lb. weight. Suppose that a man and a boy are set to carry this weight, and the man, from the boy's inability to carry his equal share, out of humanity places the weight four times as far from the boy, that is, about 6 ft. 4 in distance, and only 1 ft. 8 in from himself, then the boy will only have about 50 lb weight, while the man will have 150 lb. to bear. A hand-barrow is on the same principle; and one man may bear less or more as the load happens to be placed, or as the handles may be held to increase or lengthen the lever In yoking horses to a loaded waggon or coach having cross-bars, care is taken that the bar is hooked to the centre of the load. Sometimes a small, weak animal is placed to assist one larger and stronger; in that case, the cross-bar is not placed equally, but more past the centre for the bigger animal Thus, in dragging a plough by the chain *a* (fig 7), which is attached to the bridle, where the horses are of equal strength, the land side "swing-tree," or "whipple-tree," *e*, and the furrow swing-tree *f*, are attached by the chain to the main swing-tree

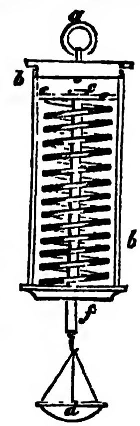


Fig 5.

Fig. 6.

b c, at points equidistant from the centre *d*, to which the chain *a* is attached. But where the one horse is much weaker than the other, its deficiency in power is compensated by yoking it to the whipple-tree *e*, which is attached to the long end of the main swing-tree *c d* (fig. 8). The strongest horse is attached to the swing-tree *f*, connected with the short end *b c* of the tree *c d*. The point of attachment *b* of the chain *a* is

capable of adjustment along the swing-tree *c d*, its pin being moved from hole to hole as required. The common operation of opening a door is an illustration of this lever: the hinges are the fulcra or centres of motion, the door the resistance or weight, and the

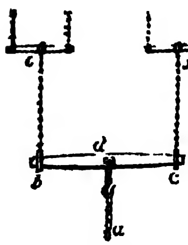


Fig 7.

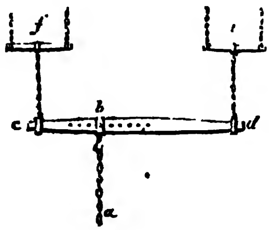


Fig 8.

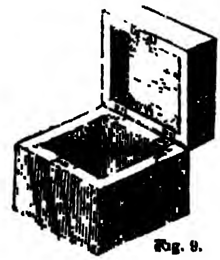


Fig. 9.

hand the moving power. The finger is painfully nipped when caught near the hinge, from that part being near the fulcrum, acted upon by a lever passing through a larger space. In opening a box the same

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is noticed (fig 9). Every one has experienced that on opening a door or gate when near to the hinge *b* (fig. 10) the force required is considerable, having little space to pass through; whereas near to the latch

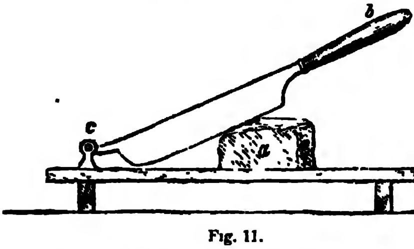


Fig. 11.

a the task is easy, though the space is increased. The oar of a boat is also a lever of this kind; the water being the fulcrum, the person who rows, the power, and the boat the resistance or weight. This lever is most powerfully employed in the coal-barges on the rivers in the North of England. These vessels retain the old Saxon name of *keels*, which is the term that distinguished the ships containing Horsa and Hengist and their enterprising followers on first coming to this country. They are in the form of half a walnut-shell, huge and unwieldy, and contain upwards of twenty-one tons of coals. The keel is propelled with one immense oar, wielded by three men remarkable for their muscular powers; they pull with all their might, adding the entire weight of their bodies, as they do not sit, but move backward with the motion of the oar: thus this heavy, clumsy barge has but the yielding water for a fulcrum, and yet is skilfully managed even among the waves of the ocean. The *masts of a ship* act as levers, having the cargo or ballast and the vessel as the resistance, the bottom of the vessel as the fulcrum, and the sails holding the wind as the moving power. Thus we see in well-equipped smuggling-vessels and gentlemen's yachts, where the masts seem enormously high for the size of the vessel, that they lean over when in full sail, by pressure on the levers, in a fearful manner. *Nut-crackers*, *lemon-squeezers*, &c., are illustrations of this kind of lever. The two legs are joined by a hinge, which is the fulcrum; the article placed between is the resistance; and the hand is the power. The *rudders* of boats, ships, &c., are levers acting on the same principle. Many are the industrial purposes to which this form of the lever is applied by chemists, grocers, chaff-cutters, coopers, patten-makers, &c. &c. The wooden soles of the shoe called a *clog*, at one time almost universally worn by boys and countrymen, was formed by this cutting-lever. In snowy or wet weather, or where persons' avocations compel them to work amid wet or stand on cold stones, this ancient shoe is invaluable in the preservation of health, being warm and dry. In the college at Manchester we have seen this cutting-lever (fig. 11) used in cutting bread; and so excellently was the work performed, that all the *fragile* delicacy of a "Vauxhall slice" was gained with a rapidity and regularity that would have caused envy in the bosom of the lessees of that place, so notorious for its transparent dainties. This lever is a common appliance in the country for bending down haystacks partially cut, and other loose light bodies that might be carried away by the wind; and it is even retained in some places for pressing cheese when in course of manufacture. A pole is stuck into a wall as a fulcrum, the resistance is the object to be pressed or held in its place, and at the other end are hung weights as the power. The *third* description of lever is that in which the fulcrum is at one end, the weight at the other, and the power placed between them. At one time this was called the *losing lever*, because the power had to be greater than the weight. The advantage of it is now discovered and appreciated, consisting, as it does, in a small power causing the extreme point of a long arm to move over a great space; and is one of those wonderful adaptations of the Divine Being in the construction of the appropriate mechanism of animals and men. A man raising a ladder, as in fig. 12, illus-

trates this form of lever. The domestic implements *fire-tongs* have two long levers with a small motion near the pivot, near which the power is applied: thus they open widely to grasp a large coal or cinder, and have a weak power at the ends, but powerful near the fulcrum. The mechanical power of the muscles of

Fig. 12.

man, acting on the bones as levers, is one of a surprising nature in the combination of power, velocity, and beauty of construction. The arm (fig 13) will be a sufficient illustration. The elbow is the fulcrum, the muscles the moving power, and the weight raised the resistance. Thus if the weight raised be 50 lb., and the elbow passes through a space of 20 inches, the muscles springing from the shoulder will contract one inch, and the force be equal to 1,000 lb. The muscles being near the joints or fulcra, give a high

Fig. 13.

degree of velocity to the other end of the lever, generating great momentum. In the human body sometimes the fulcrum is between the power and resistance, as the elbow between the muscles of the shoulder and humerus, and the hand with the weight; in other places the resistance is intermediate, and the fulcrum at the end, as the toes on the floor and the hinge of the lower jaw; and in parts the fulcrum is at the end, and the power intermediate, as the weight of the arm has its fulcrum in the shoulder-bone, and the power

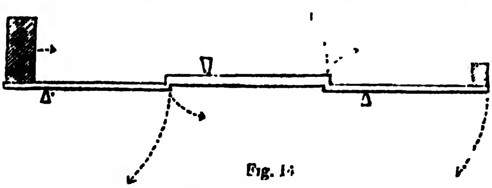


Fig. 14

is in the muscle covering and proceeding from the shoulder. The muscles of large migrating birds must also be most powerful, sustaining the weight of their bodies while they travel unrested for days amid the tempests of the heavens.

COMPOUND LEVERS are arrangements of simple levers by which less space is required: thus, suppose (fig. 14) three pieces of iron 12 inches long, having their fulcra placed 3 inches from the ends of each, let us see what 1 stone (14 lb.) moving power placed at the end of the first will balance at the end of the last. 9 inches to the fulcrum of the first lever multiplied by 1 stone is equal to 9, then the 3 inches at the other side of the fulcrum divided into 9 gives 3 stone as the balance at its end. Three stone, then, is the power at the commencement of the second lever, which must be multiplied by its 9 inches, giving as a result 27; this divided by the 3 inches at the other side of its fulcrum makes 9 stone as the power at the beginning of the third lever, which multiplied by its 9 inches results in 81, which divided by the 3 inches at the end, the total weight of the block at the other end is found to be 27 stone. It is by this kind of combination that at railway stations luggage is weighed; and at entrances to towns, where tolls are paid according to weight, carts and waggons are drawn on to tables and their heaviness known. By lengthening the arms on one side of the fulcrum and shortening them on the other, the force is greatly increased.

BENT LEVERS.—The levers we have considered are supposed to act at right angles, and the power may be the less the farther it is from the fulcrum. Bent levers are often used for their aptitude to peculiar circumstances, and act obliquely, consequently, with less effect. A bent lever balance will show the principle (fig. 15). Now, the end of the long arm where the

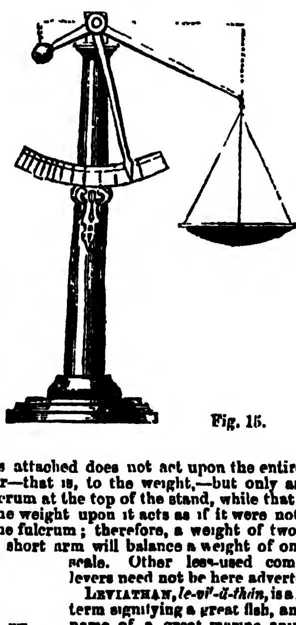


Fig. 15.

scale is attached does not act upon the entire length of lever—that is, to the weight,—but only as far as the fulcrum at the top of the stand, while that portion with the weight upon it acts as if it were not longer than the fulcrum; therefore, a weight of two pounds on the short arm will balance a weight of one in the scale. Other less-used complicated levers need not be here adverted to

LEVIATHAN, *le-vi'-ă-thăn*, is a Hebrew term signifying a great fish, and is the name of a great marine animal described in Job xli. It is very uncertain what animal is really meant by the description, some supposing it to be the crocodile, others a whale.

LEVIGATION, *lev-e-gai'-shun* (Lat. *lævigo*, I rub or grind fine), in Chem., the process of rubbing down or pounding minerals into a paste with water. Camphor, for instance, is easily reduced to powder by levigation with a few drops of alcohol; whereas, if it is pounded in the dry state, great difficulty is experienced in reducing it

LEVISTICUM, *le-vis'-te-kum* (a corruption of *ligusticum*, from Liguria, a place in Italy where it was abundant), in Bot., a gen. of umbelliferous plants The species *L. officinale*, the lovage, was once much used as a potherb, and as an ingredient in salads. The

fruits (commonly called seeds) have somewhat similar properties to those of the dill and carawky.

Levites, *le'-vites*, was applied in a general sense to all the descendants of Levi, who were set apart for the ministration of religious services, and who had no distinct territory allotted to them in the land of Canaan, like the other tribes. They were, however, to receive a tenth of the vegetable produce of the land and of the cattle. The office of the priesthood was confined to the family of Aaron, and in a more restricted sense the term Levite is applied to those of the tribe who performed the lower services of religion in the temple and throughout the country. They were also the ordinary judges of the country. In the time of David they numbered 38,000 men fit for official service; of whom 24,000 were "set over the work of the Lord," 6,000 were officers and judges, 4,000 were musicians, and 4,000 were porters.

Leviticus, *le-vit'-e-kus*, is the name of the third book of the Old Testament Scriptures, which treats principally of the rites, ceremonies, and sacrifices of the Hebrew religion. That this book was written by Moses is proved not only by Jewish tradition, but by passages in the book itself, and other parts of Holy Scripture where it is attributed to Moses. It contains the history of one month, viz., from the erection of the tabernacle to the numbering of the people who were fit for war; that is, from the beginning of the second year after the children of Israel's departure from Egypt to the beginning of the second month of the same year, 1490 B.C. The four leading topics of this book are—1. The laws concerning sacrifices, in which the different kinds of sacrifices are enumerated, together with their concomitant rites (i.—vii.); 2. the institution of the priesthood, in which the consecration of Aaron and his sons to the sacred office is related, together with the punishment of Nadab and Abihu (viii.—x.); 3. the laws concerning purifications, both of the people and the priests (xi.—xii.); 4. the laws concerning the sacred festivals, vows, things devoted, and tithes (xxiii.—xxvii.). These were all "shadows of good things to come;" and this book is of great use in explaining numerous passages of the New Testament, especially in the epistle to the Hebrews, which, in fact, would be unintelligible without it.—*Ref.* Horne's *Introduction to the Holy Scriptures*.

Lewis, *lew'-is*, in Mech., an ingenious contrivance for securing heavy blocks of stone to the tackle for hoisting. It is said to derive its name from Louis XIV., during whose reign the invention was supposed to have been first employed. This would appear, however, not to have been the case; for in the ruins of Whitby Abbey, founded in 658, there appear in the crown of the heavy keystones of the arches, cavities like those now made for the lewis in similar blocks. These are quadrangular, and spread out at the bottom on two opposite sides, as in dovetailing. Into this hole three slips of iron are inserted to fill it, altogether forming a wedge in shape, the head of which is at the bottom of the cavity. The three ends projecting out of the stone present each an eye for a bolt, which is passed through the whole, and forms a handle for raising the block. To liberate the lewis, the bolt is removed, and the middle slip, which is a straight rectangular piece of iron, is readily taken out, setting free the other two. The chain, or double lewis, has been much used in America; and in constructing the dry dock at Brooklyn, stones were suspended by it weighing from 500 to 10,000 lbs.

Lewisia, *lu-is'-e-ă* (in honour of Captain Lewis, who accompanied Clarke to the Rocky Mountains), in Bot., a gen. of the nat. ord. *Mesembryaceæ*. The root of *L. rediviva*, an American species, is eaten in Oregon. It is sometimes called tobacco-root, from the smell which it acquires by cooking. M. Geyer states that it is the *racine amère* of the Canadian voyageurs. When cooked, it is agreeable and wholesome.

Lexicon, *leks'-i-kon* (Gr. *lexis*, a word), is a vocabulary or dictionary of words, more particularly applied to dictionaries in the Greek or Hebrew language. (*See* Dictionary.)

Lex Loci Contractus, *leks lo'-si kon-trăk-tus* (Lat., law of the place where contracted), is the doctrine that all contracts made, or obligations incurred, have an implied reference to the laws of the place where the transaction occurred, unless it appear otherwise on the face of the contract.

Lex Mercatoria, or **Law Merchant**, *leks mer-kă-to'-re-a* (Lat.), in a general sense, denotes the body of usages and customs which, among civilized countries, regulate matters relating to commerce. In this general sense of the term, the subject is very indefinite, for different countries have different customs, and the mercantile usages common to all of them are few in number. In this country, it is applied to that system of laws which applies to mercantile contracts, and is based upon the custom of merchants. The law merchant is frequently referred to in the early English statutes as a well-known system, and distinct from the ordinary law. The principal subjects embraced within it are the law of shipping, including that of marine insurance; the law of negotiable bills of exchange and promissory notes; and the law of sales; all of which are treated specially in other parts of this work.

Lex Talionis, or **Law of Retaliation**, *leks tăl-e-o'-nis* (Lat.), is used to denote a mode of punishing crime, by doing to the criminal the same hurt which he has done to his neighbour. Among the Jews, as well as among the ancient Greeks and Romans, the Egyptians, &c., the law of retaliation was frequently enforced; as we read of "an eye for an eye, a tooth for a tooth," &c. In general, however, retaliation cannot be a proper measure of justice, for the difference of persons, place, time, provocation, or other circumstances, may enhance or mitigate the offence. There are, besides, many crimes that will not admit of retaliation without manifest absurdity and injustice.

Ley, or **Lye**, *lai, li*, in Chem., a technical term for the solution of an alkali.

Leyden Jar. (*See* Jar, Electrical.)

Leze Majesty, *leeze măj'-jes-te* (Lat. *læsæ majestatis crimen*), in Law, is applied to any crime committed against the sovereign power of a state.

Lias, *li'-ăs*, a term applied in Geol. to denote a peculiar formation, consisting of thick argillaceous deposits, which constitutes the foundation on which the oolite series rests. The word *lias* is believed to have had its origin in a provincial mode of pronouncing the English word *layers*. To a considerable depth, the upper portion of these deposits consists of beds of deep-blue marl, containing a few irregular beds of limestone. In the lower portion, however, the limestone beds increase in frequency, and assume the characteristic aspect of lias, presenting a series of thin stony beds, separated by narrow argillaceous partings, so that the quarries of this rock assume a striped or ribbon-like appearance when viewed from a distance. When in their purest state, these limestone beds contain about 90 per cent. of lime, the other constituents being alumina, iron, and silica. The lime afforded by the blue lias is strong, and is distinguished by having the property of setting under water. The lias clay often occurs in the form of soft slate or shale, which divides into thin laminæ, and is frequently impregnated with bitumen and iron pyrites. In consequence of this, when laid in heaps with faggots and set on fire, it continues to burn till the pyrites is decomposed. It also ignites spontaneously when it falls in large masses from the cliffs on the sea-shore and becomes moistened. The alum slate of Whitby is of this kind. The whole of the lias formation is rich in fossils, and is remarkable for its numerous remains of chambered univalves and bivalves, and certain species of fish and vertebral animals allied to the order of lizards, some of which are of enormous size. The ichthyosaurus and plesiosaurus were amongst these. (*See* Ichthyosaurus, Plesiosaurus.) The lias crosses England from Whitby, in Yorkshire, to Lyme, in Dorsetshire. Its most valuable productions are water-setting lime and alum shale. A similar formation is found in France, in the Alps, and in the Jura.

Libation, *li-bai'-shun* (Lat. *libo*, I pour), in the religious worship of the ancients, the pouring of wine or some other liquid on the altar or on the ground during sacrifice. Libations were also in use among the Hebrews, who poured a hin of wine on the victim after it was killed. It was also a custom among the Greeks and Romans at their feasts to pour out a small quantity of wine by way of libation to the gods.

LIBEL, *li'-bel* (Lat. *libellus*, Fr. *libelle*), in Law, is a malicious defamation of any person, made public by either printing, writing, signs, or pictures, in order to provoke him to wrath or expose him to public hatred, contempt, and ridicule. Libel, which is written slander, is looked upon, in law, as a greater offence than mere slander, being regarded as committed with greater deliberation, and as usually inflicting more extensive and permanent injury. Every libel is viewed as a public offence, as having a direct tendency to a breach of the public peace, by provoking the person libelled. In order to constitute a libel, it must be published; but the communication of it to any person is a sufficient publication in the eye of the law; and, therefore, the sending an abusive private letter to a man is as much a libel as if it were openly printed, for it tends equally to a breach of the peace. For the same reason it was, until very recently, immaterial whether the matter of the libel were true or false, since it was the provocation, and not the falsity, that was considered to be the thing to be punished; but by 6 & 7 Vict. c. 96, it is allowed to a defendant, in pleading to an indictment for a libel, to allege the truth of the matters charged, and that it was for the public benefit that they should be published. The truth of the libel may then be inquired into at the trial; but it shall not amount to a defence, unless it was for the public benefit that the matter charged should be published. If, after such plea, the defendant shall be convicted, the court may, in pronouncing sentence, consider whether the guilt of the defendant is aggravated or mitigated by the plea. In a civil action, however, a libel must appear to be false, as well as scandalous; for, if the charge be true, the plaintiff has received no private injury, and has no ground to demand compensation for himself, whatever offence it may have been against the public peace; and therefore, upon a civil action, the truth of the accusation may always be pleaded in bar of the suit. The sending an abusive private letter to a man does not constitute publication so as to support a civil action. By 6 & 7 Vict. c. 96, the publishing, or threatening to publish, a libel, or proposing to abstain from publishing anything, with intent to extort money, shall be punishable by imprisonment for any term not exceeding three years; and the publication of any defamatory libel, knowing the same to be false, is punishable with imprisonment for any term not exceeding two years, and such fine as the court shall award; and the bare publication of such libel shall be punishable with imprisonment for any term not exceeding one year. The printer of a libel is liable for prosecution as well as the writer; and so also is the person who sells it. In an action for a libel in a newspaper or other periodical, the defendant may plead that it was inserted without malice, and that he made, or offered to make, an apology before the action was commenced, or as soon thereafter as possible. There are certain kinds of communications that are regarded as privileged, and cannot be viewed as libellous, unless malice be proved, or may be inferred from the circumstances. Such are charges made by a master against a servant in giving his character to a party inquiring after it. Before 32 Geo. III. c. 60, the jury on a criminal trial for libel could only decide upon the fact of publication, and whether the libel meant that which was ascribed to it in the indictment; but now they may take the whole matter into consideration, and may find a general verdict of guilty or not guilty upon the whole question in issue. There is no truth in the vulgar maxim, that "the greater the truth the greater the libel." Libel is also the name given in the proceedings in the ecclesiastical courts to the articles drawn out in a formal allegation, setting forth the complainant's ground of complaint.

LIBELLULA. (*See* DRAGON-FLY.)

LIBER, *li'-ber* (Lat., bark), a term used in Bot. to denote the interior lining of the bark of exogenous plants. In this part of the bark only the woody or longitudinal tissue occurs. In many instances it is very abundant, and exceedingly tough and thick-sided, in consequence of which it is of great value for many useful purposes. When freed from the cellular tissue adhering to it, it is often manufactured into cordage, especially in trees and shrubs of the natural order *Malvaceæ*. The useful articles commonly called Russia mats are made from the thin laminæ into which the *endophlœum* of the lime-tree (*Tilia europæa*) readily separates. The lace-bark of Jamaica, remarkable for its beautiful lace-like appearance when pulled gently in a lateral direction, and for its great toughness, is the laminated liber of *Lagetta lintearia*: in consequence of its latter quality, it is twisted into whiplashes. The liber appears to be formed annually, at the same time as the concentric zones of wood, and is intended by nature to convey downwards the secretions elaborated in the bark and leaves. The term *bass*, or *bast*, is applied by gardeners to the liber of the lime-tree, which is used for making packing-mats, and also for binding up bunches of flowers, &c.

LIBERAL, *lib'-er-äl* (Lat. *liberalis*), in Polit., is a term applied to one who advocates liberal principles, the extension of popular rights or influence.

LIBERTIES OF FRANCHISE. (*See* FRANCHISE.)

LIBERTINE, *lib'-er-tin*, is a term derived from the Latin *libertinus*, which signified a freedman, a slave that had received his liberty. Libertine, in its modern sense, denotes one freed from restraint, more particularly one who leads a licentious life.

LIBERTINES, or LIBERTINI, in Eccl. Hist., were a sect of fanatics that arose in Flanders about the year 1525. They maintained that religion consists in the union of the spirit with the Supreme Being; and that, when this is attained by sublime contemplation and elevation of mind, those who have reached it may indulge, without exception or restraint, their appetites and passions, as all their actions are then perfectly innocent. They held that the Deity was the sole operating cause in the mind of man, and the immediate author of all human actions, and that men could not, properly speaking, commit sin. They spread principally in Holland and Brabant; and through the favour and protection of Margaret of Navarre, they obtained a footing in France. Calvin wrote a special treatise against them, and their spread in France was prevented. A party at Geneva got the same name, being resolute opponents of Calvin's church rule, and calling out for liberty. They made no pretence of any religious system, and were mostly persons of licentious and immoral lives, who could not bear the severe discipline of Calvin.

LIBERTY, *lib'-er-te* (Lat. *libertas*), denotes, in a general sense, a state of freedom, in contradistinction to slavery or restraint. It is either natural or civil: the former consists properly in a power of acting as one thinks fit, without any restraint or control, unless such as the law of nature imposes, being a right inherent in us by birth, and one of the gifts of God to man at his creation, when he endowed him with the faculty of free will. But every man, when he enters into society, necessarily gives up a part of his natural liberty, and, in consideration of receiving the advantages of protection, commerce, &c., he is obliged to conform himself to those laws which the community has thought fit to establish. Civil liberty, therefore, is no other than natural liberty restrained by human laws as far as is necessary and expedient for the common weal. Hence, the law which restrains a man from doing mischief to his fellow-citizens, though it diminishes the natural, increases the civil liberty of mankind; but every wanton and causeless restraint of the will of the subject, whether by a monarch or a popular assembly, is a degree of tyranny. Even laws which regulate or constrain our conduct in matters of indifference, without any good end in view, are destructive of liberty. Laws, when prudently framed, are by no means subversive, but rather introductive of liberty; for "where there is no law there is no freedom." Civil liberty, rightly understood, consists in the power of doing whatever the laws permit. The rights and liberties enjoyed in this country are, in the law books, divided into three classes.—1. The right of personal security, which accords to each individual legal and uninterrupted enjoyment of his life, his limbs, his body, his health, and his reputation; 2. the right of personal liberty, or the power of moving one's person to whatsoever place his own inclination may direct, without imprisonment or restraint, unless by due course of law; 3. the right of private property, which consists in the free use, enjoyment, and disposal of all his acquisitions, without any control or diminution, save only by the laws of the land. Liberty, in a philosophical sense, is

the power to will, or not to will, a certain act. (*See* FREEWILL.) Liberty of conscience, in church matters, denotes the power to exercise any particular form of worship free from any restraint.

LIBERTY, CAP OF, a term which may be said to arise from the following facts. The right of covering the head was always esteemed the symbol of liberty, and the first act of slaves, when they were set free, used to be the setting of a cap on the head, as, during their slavery, they always went bareheaded. The cap thus became symbolical of their restoration to freedom. This simple sign of liberty has played an active part in many a revolution. Gessler's order to salute his hat was the cause of the Swiss outbreak, and the subsequent recovery of the liberty of Switzerland. The arms of the Swiss cantons are expressive of this fact, as they have a round hat for crest. In England, a blue cap with a white border, on which is the inscription "Liberty" in golden letters, forms the symbol of the constitutional liberty of the nation; and Britannia is often represented holding this up on the point of her spear. The term *cap of liberty* is, however, more generally applied to the French revolutionary reign. It consists of a red cap (taken from those worn by the liberated slaves of Marseilles), and it was first used in the revolution of 1780. The Jacobin club afterwards made the red cap a badge of membership, and it was called the *Jacobin cap*.

LIBERTY OF THE PRESS. (*See* PRESS, LIBERTY OF THE.)

LIBERTY, TREE OF, a revolutionary symbol, first used by the Americans in their outbreak with England in the last century. A large elm was adopted at Boston, on which obnoxious characters were hung in effigy, and the following inscription was placed on it.—"This tree was planted in 1646, and preserved by order of the sons of liberty in 1766." It was thenceforth termed the *liberty tree;* but, in 1774, it was cut down by the British troops, who occupied the town. On the breaking out of the French revolution in 1789, a similar device was adopted, and a liberty tree planted by the Jacobins in Paris. The Lombardy poplar was first used, but the French name of it (*peuplier*) affording much derision, oaks or fir-trees were used instead.

LIBRA, *li'-bră* (Lat. *libra*, the balance), a constellation which gives its name to the seventh sign of the zodiac. It seems to have once formed a part of the constellation Scorpio, which then occupied two signs of the zodiac, the body being in one part, and the claws, now called Libra, in the other. It lies between Scorpio, Virgo, the Centaur, and Lupus. Its largest stars are of the second magnitude. The sun enters Libra at the commencement of the vernal equinox, and the name was probably given to this constellation and sign of the zodiac, in allusion to the equality that exists at that time between day and night.

LIBRARIES, PUBLIC.—The importance of establishing public libraries was first brought under the notice of parliament in 1848, when Mr. W. Ewart, M.P. for the Dumfries burghs, moved for the appointment of a select committee of the house to report upon the subject. Information was collected regarding the management and benefits of public libraries in other countries, witnesses were examined; and the conclusion arrived at was, that this country was far behind others in the matter of public libraries, and that "our present inferior position" was "unworthy of the power, the liberality, and the literature of the country." In 1850, Mr. Ewart moved for leave to bring in a bill for enabling town-councils to establish public libraries and museums by levying a rate, not exceeding one halfpenny in the pound, on the general assessment of the town. After considerable opposition, it passed both houses, and received the royal assent on the 14th of August. On 20th March, 1854, Mr. Ewart moved for leave to introduce a bill to "amend and extend an act for enabling town-councils to establish libraries and museums freely open to the public;" but various delays and difficulties prevented the successful prosecution of the measure until next session, when it was carried through, and obtained the royal assent on 30th July, 1855. This act (18 & 19 Vict. c. 70) is applicable—(1) to all municipal boroughs having a population, by the last census that shall have been taken, of more than 5,000 persons; (2) to all districts of like population having an improvement-board; (3) to all parishes of like population; and (4) to any two or more neighbouring parishes that may unite for that purpose, and which have an aggregate population of more than 5,000. In order to its adoption, a public meeting of the ratepayers must have been duly convened, and the proposition for its adoption must have been voted by at least two-thirds of the persons then present. The town-council, or improvement-board, or parish vestry, as the case may be, then becomes empowered to levy a library-rate, not exceeding one penny in the pound, on the rateable value of the assessable property in the borough, district, or parish. The library rate may be applied wholly to the establishment of a library, or partly to a library and partly to a museum. The management and control of the libraries and museums thus established is, in a city or borough, vested in the council; in a district, in the improvement-board; and in a parish, in commissioners to be named by the vestry. The commissioners must be ratepayers, and not less than three or more than nine. This managing body has power to provide books, newspapers, maps, specimens of art and science, and all other needful matters; and to employ the requisite officers and servants: admission to all the libraries established under the act to be free of all charge. Other acts make similar provisions for Scotland and Ireland. The first library established under the Public Libraries Act of 1850 was that of Manchester. Liverpool speedily followed the example; then Norwich, Winchester, Sheffield, &c. Almost all the libraries which have been founded under the act include both reference and lending departments. In the lending department of the Manchester library, no one is allowed to borrow a book from the library without having first obtained an obligation signed by two ratepayers on the burgess-roll of Manchester or Salford, undertaking to replace any book which may be lost or materially injured by the person borrowing.

LIBRARIES, ITINERATING, are libraries or collections of books which are removed from one place to another after a certain time, when a new collection takes their place. The idea originated with Mr. Samuel Brown, of Haddington; and as an instance of the working of the institution, we quote his words as given in McCulloch's "Geographical Dictionary," art. Haddington:—

In 1835 there were, in East Lothian, forty-three divisions of these libraries of fifty volumes each. Each division remains for two years in the same place, when it is removed to another locality, and succeeded by a new supply of books of the same number; so that each locality has a fresh supply of new useful reading every two years. .... The use of the books is gratuitous, if so wished, but never more than a penny per annum has been systematically taken from any reader; but voluntary contributions, either in books or money, are received." The system has been extended to various other parts of Scotland, as also of England, Ireland, Canada, &c. The numerous parish and other libraries that have been established since that system was introduced, have rendered it less necessary, and now it is carried on but in few parts.

LIBRARY, *li'-brā-re* (Lat. *liber*, a book), denotes both a collection of books and the apartment or edifice in which they are contained. The most ancient library on record was founded by Osymandyas, king of Egypt, a contemporary of David, king of Israel. At a very early date the Jews attached collections of books to most of their synagogues; and we are told that Nehemiah founded a public library at Jerusalem. In the recent discoveries in Assyria, a vast collection of clay tablets, bearing cuneiform inscriptions, was found in the palace at Nineveh, forming what has been termed a "library in clay." Pisistratus of Athens is said to have established the first public library in Greece, and to have collected, at great trouble and expense, the works of Homer. Aristotle is the first person on record who was possessed of a private library. After the death of Alexander, the love of science and literature generally passed from Athens and Greece to Alexandria, where was formed the most magnificent library of ancient times: it is said to have contained no fewer than 700,000 volumes. (*See* ALEXANDRIAN LIBRARY.) Next to the Alexandrian library, that of Pergamus was the most renowned, and is said to have contained 200,000 volumes. The first library established at Rome

was probably that founded by Paulus Æmilius, B.C. 167. Having defeated Perseus, king of Macedonia, he brought his library to Rome; and this collection was subsequently augmented by the library of Apelloon the Teian, brought by Sylla from Athens. From the intercourse of the Romans with the Greeks, the passion for forming libraries rapidly increased, and individuals began to pride themselves on their private collections. Among the illustrious Romans who have been noted for their magnificent libraries, are Asinius Pollio, Crassus, Cæsar, Lucullus, and Cicero. Among the projects formed by Cæsar was the establishment of a public library; and the duty of selecting and arranging it was assigned to Varro; but the design was frustrated by the assassination of the emperor. Among the benefits conferred by the emperor Augustus upon Rome was the erection of two public libraries,—the Octavian and the Palatine. The successors of Augustus, though they did not equally encourage learning, were not altogether neglectful of its interests. Tiberius founded a library in the new temple of Apollo; Vespasian established a library in the new temple of Peace; and even Domitian, in the early part of his reign, restored, at vast expense, the libraries in the Capitol which had been burned; and to this end both collected MSS. from various countries, and sent scribes to Alexandria expressly to make copies of works there. The most magnificent library, however, founded by the emperors at Rome was that of the emperor Ulpius Trajan, from whom it received the name of the Ulpian library. Constantine the Great, after removing the seat of his empire to Constantinople, is said to have given a large share of his attention to the formation of a library, and to have bestowed especial pains in the rescue, as far as possible, of those Christian works which had been doomed to destruction by his predecessor Diocletian. The task was continued by his son Constantius, Theodosius II., and others, until it comprised, according to some accounts, upwards of 100,000 volumes. The emperor Leo III. is stated to have burnt a considerable library at Constantinople in 730; and between this time and the capture of Constantinople by the Crusaders, several such casualties are related to have occurred. This last calamity, however, eclipsed all previous losses, and, two hundred and fifty years later, it was followed by the final destruction of the empire; the imperial library, however, was preserved by the express command of Mohammed, and was kept in some apartments of the seraglio. Whether it was destroyed by Amurath IV., as is commonly supposed, or allowed to fall into decay, is uncertain; but there are not a few scholars of eminence who still believe that ancient and valuable MSS. are concealed in the seraglio of the Sultan, though it has been repeatedly asserted that the library of the Sultan does not contain one Greek or Latin MS. of any importance. The manner in which the ancient books were written (upon rolls) greatly increased the number of volumes; and it is said that "the largest libraries in ancient times might be represented by the contents of a modern library containing from 50,000 to 100,000 volumes."—(*Edwards.*) Comparatively little is known of the libraries of the middle ages. It is usual to speak of these as "the dark ages," and to look upon them as a period when learning and intellectual culture were almost extinct. Among the people generally this may have been the case; but they still had an abiding-place in the monasteries, to an extent that those unacquainted with the inner history of the period would scarcely credit. Many of the monks gave themselves not only to the study but to the transcribing of books; and to their care and labour we are indebted for many of the ancient works that have come down to us. Foremost among the cultivators of learning and the arts stands the order of St. Benedict, which had the good fortune to include a number of men remarkable for mental vigour and force of character. Many of these religious houses had considerable libraries attached to them, catalogues of several of which have been printed in recent times. In Alexandria, the Arabians had a considerable collection of Arabian books; and Al Mamoun collected many Greek manuscripts in Bagdad. In the West, libraries were formed in the second half of the 8th century by the encouragement of Charlemagne. In France, one of the most celebrated was that in the abbey of St. Germain des Près, near Paris. In Germany, the libraries of Fulda, Corvey, and, in the 11th century, that of Herschau, were valuable. In Spain, in the 12th century, the Moors had seventy public libraries, of which that of Cordova is said to have contained 250,000 volumes. In England and Italy libraries were also founded with great zeal, particularly in the former country by Richard Aungerville, in the latter by Petrarch, Boccacio, and others. The revival of learning is usually dated from the middle of the 15th century. On the fall of Constantinople in 1453, many of its inhabitants emigrated into Italy, and were the means of awakening an interest in classical learning. The appetite for books was revived and quickened, and no labour or expense was spared in acquiring them, learned men being despatched in all directions to collect manuscripts. The invention of printing was of great service, as enabling collections of books to be made at less trouble and expense. Several of the great libraries of Europe date their first beginnings prior to 1465, when the art of printing had been established, but without having, as yet, materially affected the labours of the copyists; as the imperial libraries of Paris and Vienna, the Laurentian library at Florence, and the library of the Vatican. Town libraries had also begun to be formed in various parts, particularly of Germany and France. In this respect England stands in striking contrast to other countries, being centuries behind them. In 1570, Sir Humphrey Gilbert in vain pressed upon the attention of Queen Elizabeth the importance of establishing a public library, after the pattern set us by "the more civilized nations; as Germany, Italy, and France." In fact, it was not until the reign of James I. that Great Britain could boast of even a royal library worthy of the name. The Bodleian library was founded in 1597, and down to 1753, when the British Museum library was formed, it continued to be the only one of national importance. Referring for further information on this subject to Edwards's "Memoirs of Libraries and Handbook of Library Economy," and his article on Libraries in the "Encyclopædia Britannica," to Guild's "Librarian's Manual," Rhees's "Manual of Public Libraries in the United States," and a long and interesting article on Library in the "English Cyclopædia," we give here a table of the principal libraries, with the number of volumes, &c., in each, according to the latest reports:—

Place.	Name.	When Founded.	No. of Volumes. Printed.	MSS.
London	British Museum	1753	600,000	40,000
Oxford	Bodleian	1597	260,000	22,000
Cambridge	University	1475	197,000	3,163
Edinburgh	Advocates'	1680	172,000	2,000
,,	University	1580	100,000	400
Dublin	Trinity College	1602	126,000	1,600
Paris............	Imperial	1377	850,000	8,400
,,	Arsenal	1789	202,000	6,000
	St. Geneviève...	1624	180,000	3,500
,,	Mazarin	1660	132,000	3,000
Strasburg......	Town................	1531	180,000	1,590
Bordeaux	Town	1738	123,000	320
Munich.........	Royal................	1550	800,000	18,600
Berlin	Royal	1661	500,000	10,000
Vienna	Imperial	1440	350,000	20,000
,,	University	1777	120,000	—
Dresden	Royal	1555	300,000	2,800
Gottingen .	University	1736	300,000	5,000
Wolfenbüttel	Ducal	1604	200,000	4,500
Tubingen	University	—	200,000	20,000
Stuttgart	Royal	1765	200,000	18,000
Leipsic	University	1543	160,000	2,500
Hamburg......	Town	1529	150,000	5,000
Gotha	Ducal	1640	180,000	5,000
Darmstadt ...	Grand-Ducal ...	1760	300,000	4,000
Heidelberg ...	University	1703	200,000	3,000
Weimar	Ducal	—	140,000	—
Prague	University	1350	130,000	4,000
Breslau...	University	1811	350,000	2,000
Augsburg .	Town	1537	118,000	394
Hanover ...	Royal	1690	120,000	—
Erlangen	University	1743	100,000	500
Brussels	Town................	1350	200,000	18,000
,,	Royal	1837	115,000	15,000
The Hague ...	Royal	1735	100,000	2,000

Place.	Name.	When Founded.	No. of Volumes Printed.	MSS.
Rome	Vatican............	1450	300,000	24,00[illegible]
Bologna	University	1690	150,000	11,00[illegible]
Naples	Royal	1780	150,000	4,76[illegible]
Turin...........	University	1436	115,000	3,00[illegible]
Venice	St. Mark's	1496	103,000	10,00[illegible]
Florence ..	Magliabecchian	1714	150,000	12,00[illegible]
"	Laurentian	1444	120,000	6,00[illegible]
Milan	Brera	1763	125,000	1,00[illegible]
Madrid	Royal	1712	125,000	2,50[illegible]
St. Petersburg	Imperial	1747	450,000	25,00[illegible]
"	Academy	1726	110,000	—
Copenhagen	Royal	1550	410,000	18,00[illegible]
"	University	1730	100,000	4,00[illegible]
Upsal ..	University	1621	135,000	7,00[illegible]
Christiania .	University ....&.	1811	120,000	60[illegible]
New York	Astor	1839	100,000	
Boston	Athenæum	1804	75,000	
"	Public City	1852	70,000	
Cambridge, Mas. .. .	Harvard College	1764	75,500	
Philadelphia	Library Co , &c.	1731	70,000	
Washington D.C.	Congressional ..	1851	50,700	—
Albany, N.Y.	State	1818	53,500	—

Even though these figures were more reliable than w[e] believe them to be, it is evident that the accuracy o[f] this mode of estimating the size of a library will depen[d] very much upon what is reckoned a volume. In th[e] continental libraries, works are regarded as separat[e] volumes which, in the British Museum library, would be counted only as one. Thus, three-volume novels, at the Museum, are usually bound into one, and reckoned only as one volume, whereas in the other libraries they would be counted as three; and the same with many others. Hence, relatively, the number o[f] volumes in the Museum library is much greater than appears on this list; and we believe that actually, in point of size, it is inferior only to that of Paris.

Libration of the Moon, *li-brai'-shun* (Lat *libra*, a balance).—The term libration signifies a slight oscillation or rocking motion from side to side of a certain position, the body in libration inclining first to one side and then to the other, as any body will do whose equilibrium has been disturbed. The expression "libration of the moon" is applied to an irregularity in the moon's motion, through which the moon does not at all times present the same face to an observer on the earth's surface. The moon accomplishes her revolutions about her axis and in her orbit in the same *mean* time. Now, if the moon's motion in her orbit were uniform at all times during the period of revolution, and if the plane of her equator passed through the centre of the earth, the moon would always exhibit the same face to an observer in that position; but as this is not the case, and as the moon's orbital motion is irregular, the axis of the moon does not always preserve the same inclination to an observer on the earth, but appears to have a slight oscillatory motion, through

east, and west, are alternately presen
from view at regular periodic times.

Libretto, *le-bret'-to* (Ital , a small book), a term applied to the words constituting the text of an opera. Perhaps the best, and certainly the most fertile, writer of libretti, is Eugène Scribe, the French author. Among the best German writers of libretti may be quoted Kind for Weber's "Freischutz," and Von Chezi for "Euryanthe."

any time be countermanded. The term license is more particularly applied to the authority given by government to persons to carry on certain trades or professions, and for which a duty is payable to the state. (*See* Taxation.) License of marriage is a permission which may be granted by bishops for marrying certain persons; and parsons marrying without a license, or without publishing the banns of matrimony, incur a penalty. (*See* Marriage.)

Licentiate, *li-sen'-she-ait* (Lat. *licentia*), means one who has a license to exercise a profession. In some foreign universities it means a degree; but in England it is unknown, except in the instance of the degree of licentiate of medicine granted by the university of Cambridge.

Lichenes, Lichens, *li'-ken-eez*, *li'-kens*, or *litsh'-e-nees*, *litsh'-ens* (Gr. *leichen*), in Bot., the Lichen ord. of thallogenous *Acotyledones*, consisting of perennial plants, composed of parenchymatous cells, arranged so as to form a foliaceous, somewhat woody, scaly, crustaceous, or leprous thallus, living and fructifying in the air, and growing on the bark of trees, on old palings, walls, rocks, &c.; usually epiphytic, but sometimes parasitic, and commonly presenting a dry, shrivelled, more or less lifeless appearance. Lichens are distributed over all parts of the world, and form a considerable proportion of the vegetation of the polar regions and of mountain-tops. Many species possess nutritive properties, from containing starchy matter, such being also emollient and demulcent. Others contain bitter principles, which render them tonic and astringent Several, again, are important as dyeing agents. None are known to be poisonous. (*See* Cetraria, Grophora, Lecanora, Roccella.)

Lictor, *lik'-tor* (probably from Lat *ligare*, to bind), Roman officers of state who attended on the early Roman kings, and afterwards on the chief magistrates of the republic,—the consuls, decemvirs, dictators, and master of the horse. Each bore on his shoulder a bundle of rods bound about an axe, which was emblematical of the power of the magistrate to inflict punishment by death and by scourging. It was the duty of the lictors to carry out the orders of the magistrate with regard to those who were found guilty of any offence against the state or private individuals, and it is supposed that they derived their name from having to bind criminals before inflicting capital or corporal punishment on them. The bundles of rods and axes that the lictors carried as emblems of the regal and consular dignity were termed *fasces*.

Liege, *leeje* (Fr. *lige*, from Lat. *ligare*, to bind), properly denotes one bound, or united by allegiance, to another. Hence a liegeman is one who owes allegiance to a superior, and a liege lord is a superior to whom such allegiance is due. Subjects are lieges of their king, who is their liege lord.

Lien, *le'-en*, or *li'-en* (Fr , bond), in Law, is the right of a creditor to retain the property of his debtor until his debt has been paid Liens are either general or specific. A general lien is a right to retain certain goods until all the claims of the holder against the debtor are satisfied. This sort of lien is not favoured by the law. A specific lien is the right to retain certain goods for claims arising from these goods. Thus, in the sale of any article, the vendor has a right to retain it until the price agreed be paid. As a general rule, a workman may retain any article which he has improved for the price of his labour; as a tailor who has received cloth to make into a coat may retain the coat until he is paid for the labour of making it. An innkeeper may retain the goods of his guest until the amount of his bill is paid. Liens are implied by law, or authorized by custom; or they may be created by express contract. The custom, however, to be legal, must be reasonable; but this does not apply to special contract, which is good, though it may also be foolish or hard. Lien can exist only where the possession of the goods has been legally obtained, and ceases to exist the moment they are parted with. A lien can only be based upon a present existing claim. It is not affected by the lapse of time, like a simple debt; for the lien exists so long as the creditor continues to retain the goods in his possession *Maritime lien* applies to ships, freight, or cargo, and differs from the other in not depending upon possession, and requiring a legal process for its enforcement. It may arise by law or by special contract. Seamen have a lien on the vessel for their wages. Bottomry is also a lien established by special contract, on a vessel for repairs or necessaries supplied to her to enable her to complete her voyage.

(*See* BOTTOMRY.)—*Ref. English Cyclopædia*—Arts and Sciences.

LIENTERIA, *li-en-te-re-ă* (Gr. *leios*, smooth; *enteron*, the intestine), is a species of diarrhœa in which the food passes through the body in an almost unaltered state. (*See* DIARRHŒA.)

LIEUTENANT, *lef-ten'-ănt* or *lu-ten'-ănt* (Fr.), a subaltern officer, who takes rank next to the captain of a company, and who fills his place and discharges his duties in case of his death, or whenever he happens to be absent from the men under his command. In Mil., the term is applied as a prefix to the words *general* and colonel, to form the titles of officers who take rank next in order to generals and full colonels, and who form the second grade of general and field-officers respectively. (*See* GENERAL, LIEUTENANT-COLONEL.) In the marines, two lieutenants are allotted to a company instead of a lieutenant and *ensign*, the junior lieutenant being styled second-lieutenant, and in the artillery there are two lieutenants to every battery; but the junior lieutenant only receives a lower rate of pay, and is not distinguished by any difference of title, as in the marines. This is also the case in the engineers. In fusilier regiments, the junior subaltern officer of a company was formerly styled second-lieutenant, but he is now called ensign. In the army, the lieutenant is distinguished by a crown on either side of the collar of his coat or tunic. In the navy, the senior lieutenant on board any vessel is distinguished as first-lieutenant, except he be in command of a gunboat or small vessel. Lieutenants in the navy rank with captains in the army. A lieutenant in the navy receives 10*s. per diem* when on active service; but when he has the command of a vessel, or is a first-lieutenant of seven years' standing, he receives a shilling a day more. The number of lieutenants appointed to vessels varies in proportion to their rating; a vessel of the first-rate carrying eight, with supernumeraries; one of the second rate, seven, and one of the third rate, six, and so on to sloops, which carry two.

LIEUTENANT-COLONEL, a field-officer that takes rank above a major, and next to a full colonel The lieutenant-colonel always has the actual command of the regiment or battalion to which he is attached, and is responsible for the drill and discipline of the men under him, the coloneley of the regiment being an honorary appointment, involving certain privileges without the performance of any duties in connection with the post, which is always bestowed on some general officer for long and distinguished services

LIEUTENANT-GENERAL. (*See* GENERAL.)

LIFE, *life* (Sax. *lyf*, *lyf*), is defined to be that "state or condition of a being that exhibits vital actions," and it is thus placed in opposition to the term death, which implies the state of a being in which those actions have altogether ceased, and whose structure is subject to no other forces than those of inorganic matter, which speedily effect its decomposition. The class of phenomena to which we apply the term vital, and which differs in its character both from those of physics and chemistry, is only manifested by bodies of that peculiar structure which we term organized. It was long regarded as sufficient to attribute to the vital principle all those actions of a living body which cannot be referred to the laws of chemistry or physics The laws of vital phenomena, however, are, in fact, as open to investigation as those which comprehend the phenomena of gravitation, electricity, or chemical affinity. A strict examination into their character will show that, although not identical with physical phenomena, they are analogous to them, in so far as they take place according to a regular plan, and present themselves under fixed conditions, a definite acquaintance with which would give to physiological science the same kind of precision and comprehensiveness as it is the aim of the physical philosopher to attain in his branch of study. The intricacy, however, of the combinations under which the vital phenomena are usually presented to our observation renders a knowledge of their laws more difficult of attainment; but the success which has attended the philosophical method of inquiry of late pursued by scientific physiologists, is a most satisfactory proof that they are not beyond the reach of persevering and well-directed search. Life commences with the first production of the germ; it is manifested in the phenomena of growth and reproduction; and it terminates in the death of the organized structure, when its component parts are disintegrated more or less completely by the operation of the common laws of matter. Life is thus "the sum of the actions of an organized being." It includes all those phenomena which it is the province of the physiologist to consider. (*See* PHYSIOLOGY.) The changes exhibited by any one living being, in its normal condition at least, have one manifest tendency,—the preservation of its existence as a perfect structure. By these it is enabled to counteract the ever-operating influence of chemical and physical laws, and to resist to a greater or less extent the injurious effects of external agencies. In the investigation of vital phenomena, the fact has been too much overlooked, "that we always find a similarity of action when the organised structure on the one hand, and the stimuli which call its properties into activity on the other, are identical; and a difference in either of these conditions always produces a difference in the result." We do, indeed, occasionally find variations in the result, without being able to detect any change in either of the conditions; but knowing how very imperfect our powers of discovering minute changes at present are, and bearing in mind that every increase of our means of observation has gone to strengthen the force of our rule, we cannot look upon them as exceptions. In attempting to reduce the mass of phenomena presented to us by vital actions to distinct classes, we find that all living beings introduce into their own structure alimentary substances derived from external sources; and likewise that all submit their fluid ingredients to the influence of the element which they inhabit, so as to produce a reciprocal change between them. Thus, the function of respiration is essentially the same throughout the whole organized world. Hence we conclude that the action of each particular organ is dependent upon the excitation of its properties by agents external to it When these stimuli are withdrawn, vital action ceases Farther, every class of organs in the living body may be said to require its particular stimulus for the display of its properties. There are also other conditions of a more general nature necessary for the support of vital actions. All vital actions require a certain amount of heat for their performance, and this amount varies in different cases Light, again, is essential to many others, especially in the vegetable kingdom. Electricity is also an important agent in the vital economy; but our knowledge of its operations is still very imperfect. Many physiologists argue for the existence of a distinct set of vital affinities, from the fact that the tissues and fluids which maintain a certain composition when possessed of vitality, rapidly resolve themselves into new combinations when this has some extent; but there appears to be more reason to infer that the preservation of the normal constitution of organic compounds in the living body is dependent on the continuance of the vital actions of the economy, rather than due to its mere possession of the property of vitality. In fact, it may be reasonably maintained "that the vitality of each tissue, that is to say, its possession of vital properties, is dependent on the perfect condition of its organization; and that, so far from preserving the organism from decay, it merely remains until decay has commenced." There are many organized beings, at particular periods of whose existence all vital action seems to be suspended; and this may result either from the absence of the stimuli necessary to maintain it, or from some change in the organism itself, by which it is, for a time, less capable of responding to these stimuli. The former is manifested in a remarkable manner in the case of seeds of plants, which have been found to preserve their vitality during many centuries; the latter, in the case of certain animals which pass the winter in a state of torpor.—*Ref.* Todd's *Cyclopædia of Anatomy and Physiology*; Carpenter's *Principles of Physiology*; Carpenter's *Principles of Human Physiology*; Müller's *Elements of Physiology*.

LIFE ANNUITY. (*See* ANNUITY.)

LIFE-BOAT, *life'-bote*, is a boat constructed with great strength to resist shocks, for preserving lives in cases of shipwreck or other destruction of a ship or steamer. Besides being made very strong, life-boats

are so constructed as to possess sufficient buoyancy to enable them to float though loaded with men and filled with water. Boats of this kind are maintained at most of the ports of this kingdom, and are always in a state of readiness to put to sea when a vessel is seen to be in danger of shipwreck. They are also provided with means for being conveyed to the shore and launched as quickly as possible. In 1785 Mr. Lukin obtained a patent for a life-boat with projecting gunwales, and hollow cases or double sides under them, together with air-tight lockers under the thwarts. The buoyancy of the boat was increased by these contrivances, and the liability to roll was counteracted by the air-tight cases under the gunwales. This boat, however, was not strong enough, and was liable to be staved in at the sides. Greathead's life-boat, invented in 1789, was a superior vessel; it had five thwarts or seats for rowers, double-banked, so as to be manned by ten rowers, and was cased and lined throughout with cork, so that it could float serviceably when almost knocked to pieces. In 1804 this boat had saved nearly three hundred lives from vessels wrecked off the mouth of the Tyne, when the Society of Arts presented Greathead, its inventor, with their gold medal and fifty guineas. During the next forty years several other life-boats were introduced, but their form was merely a modification of those in use before. A lamentable accident occurred, about 1850, to a life-boat at South Shields, when twenty pilots were drowned. In consequence of this casualty, the duke of Northumberland, as president of the National Shipwreck Institution, offered a reward for the best model of a life-boat. This offer was responded to by boat-builders and others from many parts of this kingdom, as well as from France, Germany, Holland, and America. About fifty of the best of these were exhibited by the duke in the Exhibition of 1851. All the models sent in were patiently examined by a committee, who drew up a list of all the good qualities of a life-boat, and noted down the rank of each of the plans in reference to each quality. After being examined in this way, the prize was given to Mr. Beeching, of Great Yarmouth, as the constructor of the life-boat which combined the largest number of good qualities. This boat had a moderately small internal capacity, under the level of the thwarts, for holding water, and ample means for freeing [illegible] any water that might be shipped. She was ballasted by means of water admitted into a well or tank at the bottom after she was afloat; and by means of that ballast, and raised air-cases at the extremities, she was able to right herself in case of being upset. Mr. Peake, the master shipwright of Portsmouth, was one of the committee who decided upon the bestowal of the prize; he afterwards designed a boat which comprised many of the features of the competitive boats, and added others suggested by his experience. This boat, gradually improved in time, is now looked upon as the English model life-boat, and is exclusively adopted by the Life-boat Institution. Boats similarly constructed have been sent to Russia, Prussia, Spain, Portugal, and the colonies. Peake's life-boats are of two sizes; the larger is 32 feet long, 8 feet wide, and 4 feet deep; it weighs 3 tons, costs £156, and is worked by 10 oars. The smaller boat is 28 feet long, 7 feet wide, and 3 feet deep; it weighs 25 cwt., costs £128, and is worked by 6 oars. In connection with these life-boats may be mentioned the National Life-boat Association, founded in 1824, the objects of which were,—to grant funds for making life boats, boat-houses, and life-buoys; to assist in training boatmen and coast-guardsmen to aid ships in distress; to interchange information with local bodies concerning appliances for the saving of life; and to reward those who might afford assistance to ships in distress, &c. During a period of thirty-one years this association was instrumental in saving 9,228 persons from shipwreck. In 1854 the supervision and control of merchant ships was vested in the Board of Trade by an act of parliament which also related to life-boats. In 1859 there were 88 life-boats belonging to the Life-boat Institution, besides 70 others belonging to various harbour commissioners, dock trustees, Trinity-houses, ballast-boards, fisheries commissioners, local committees, &c. A little manual has been published by the Institution, giving full instructions how to manage a life-boat.

LIFE-BUOY, *life'-boy*.—The first of these contrivances for saving human life was the invention of Lieutenant Cook, and his invention was immediately adopted by the Admiralty for the use of the British navy. It consisted of two casks connected by a bar, each about as large as an ordinary-sized pillow, and of buoyancy and capacity sufficient to support a man standing on them. In case more than one person should require support, several could lay hold of rope beckets (*i. e.*, handles or loops made of rope), fitted round the buoy, and thus they could sustain themselves. Between the two casks a hollow pole or mast was erected, into which was inserted an iron rod loaded with lead at the lower extremity, so that when the buoy was let go, this rod slipped down to a certain extent, thus lengthening the lever and enabling the lead to act as ballast: by this means the mast was kept upright and the buoy prevented from upsetting. The weight, also, at the end of the rod was so managed as to afford firm footing for two persons, should that number reach it, and the rope beckets before alluded to supplied assistance to many more. To the head of the perpendicular mast a fuse is attached at night-time, on a brass fuse-plate, the shank of which is secured into a socket by a thumb-screw. The buoy is fastened to the ship by the chain only, the ring of which hangs on the hook of the sheave of the trigger-plate. Attached to the stern of the vessel are two iron rods cased with copper tubing, together with the screw-bolts from which they are suspended; just above the forked stay which keeps the rods parallel at a proper distance from the stern, is the trigger-plate and the brass fuse-case which covers and protects the fuse on the head of the staff. In addition to this, there is also a brass case for the lock, and a percussion-hammer placed so as to communicate with the fuse-case by means of the horizontal tube; all these, together with the pulleys and guard-iron, are firmly attached to the stern of the vessel, inside of which, immediately opposite the pulleys, are fixed the caps and handles, the one for firing the lock and lighting the fuse, the other for raising the trigger-bolt and disengaging the buoy from the vessel. As soon as the trigger-bolt is raised, the sheave revolves, the stop turns round, and the life-buoy slides off the rods into the water, bearing on the head of the mast a brilliant flame. This apparatus admits of being lighted and let down into the water in the short space of five minutes after the alarm of "man overboard" has been given; and Lieutenant Cook obtained the gold medal of the Society of Arts for its invention in the year 1818. Many forms of life-buoys have been made of india-rubber, as is mentioned in another article (*see* LIFE-PRESERVERS); but the buoy which is generally used in the mercantile marine in the present day, as well as in some of the ships of the royal navy, may be thus described:—It is composed of slices of cork, so arranged as to form a buoyant zone or belt of about thirty-two inches extreme diameter, and six inches in width, with a thickness of four inches, and containing about twelve pounds' weight of cork. This mass is compactly covered with painted canvas, and is furnished with loops of rope all round its circumference. Several of these are generally supplied to sea-going vessels, and they are placed in conspicuous positions, so as to be at hand in case of emergency. A new life-buoy was invented by Mr. W. B. Dennys, of H.M.S. *Britannia*, in the year 1859, and it is thus described by him in a letter to the "Mechanics' Magazine" of the 7th October in that year:—"This invention consists of a hollow copper buoy, with a suspended stanchion in the centre to support the light. Two indentations, one on the upper and the other on the under surface of the buoy, opposite to each other, allow this stanchion to assume a perfectly horizontal direction to the plane of the ring when suspended; on being let go, it becomes perpendicular, and is locked in that position by a catch. It is nearly impossible to capsize this buoy. Hollow copper balls suspended on the same guides, or on others at the ship's quarters, give an additional chance of safety to a drowning person, as, even if ten or twelve feet distant from the buoy, he may manage to draw himself to it by their aid. It may be either freed in the usual way, the present guides, slip, and percussion-hammer being retained, or a friction-tube may be used, firing the fuse by the weight of the buoy on being let go." This

form of life-buoy is annular, like the common cork buoy just previously described, and it appears to possess many advantages over that, as well as over the old form of Lieutenant Cook's invention. (*See* LIFE-PRESERVERS.)

LIFE ESTATES, in Law, are estates of freehold, not of inheritance, but for life only; and of these some are conventional, or expressly created by the act of the parties; others merely legal, or created by construction or operation of law. Estates for life of the former kind, expressly created by deed or grant, are where a lease is made of lands or tenements to a man to hold for the term of his own life, or that of any other person, or for more lives than one; in any of which cases he is styled tenant for life; only when he holds the estate for the life of another, he is usually styled *pur autre vie*. These estates for life, like inheritances, are of a feudal nature, and were at one time the highest estate that one could have in a feud which was not in its origin hereditary. They are given or conferred by the same feudal rights and solemnities, the same investiture or livery of seisin, as fees themselves are. Estates for life may also be created by a general grant, without defining or limiting any specific estate. As if A grant to B the manor of Dale, this makes him tenant for life; for, as there are no words of inheritance, it cannot be construed as a fee, yet it shall be construed to be as large an estate as the words of the donation will bear, and therefore an estate for life. Also, such a grant at large shall be construed to be for the life of the grantee, in case the grantor hath authority to make such a grant. Besides these estates, which, generally speaking, endure as long as the life for which they were granted, there are estates for life, which may determine upon future contingencies before the life for which they are created expires; as where an estate is granted to a widow during her widowhood, or to a man until he be promoted to a benefice. These, while they subsist, are reckoned estates for life; because the period of their duration is uncertain, and they may possibly last for life. The incidents to an estate for life are principally the following:—1. Every tenant for life, unless restrained by covenant or agreement, may, of common right, take, upon the land demised to him, reasonable estovers or botes, that is, an allowance of wood for fuel, repairs, &c.; but he is at the same time liable for waste or injury done to the premises during his inheritance.—2. He, or his representatives, shall not be prejudiced by any sudden or unforeseen determination of his estate; therefore, if a tenant for his own life sows the lands and dies before harvest, his executors shall have the emblements or profits of the crop.—3. Under-tenants, or lessees, have the same, nay, even greater indulgences, than their lessors, the original tenants for life; for the law of estovers and emblements, as affecting the tenant for life, apply also to the under-tenant; and farther, where the tenant for life shall not have the emblements because the estate determines by his own act, the exception does not reach his under-tenant, who is a third party. A tenant for life, or for any greater estate, either in his own right or in right of his wife, may now, by 19 & 20 Vict. c. 120, subject to the exceptions and limitations therein contained, make effectual leases of the same, or any part thereof, for a term not exceeding twenty-one years. By 14 & 15 Vict. c. 25, it is enacted, that where, in the case of under-tenants, the lease or tenancy shall determine by the death or by the cesser of the estate to the landlord, the tenant shall, instead of claims to emblements, continue to hold until the expiration of the then current year of his tenancy, and shall then quit, upon the terms of his lease or holding, in the same manner as if his tenancy were determined by effluxion of time, or other lawful means, during the continuance of his landlord's estate; and the succeeding owner shall be entitled to recover a fair proportion of the rent for the period elapsed from the termination of the landlord's interest to the time of quitting.

LIFE-GUARDS. (*See* HOUSEHOLD TROOPS.)

LIFE INSURANCE. (*See* INSURANCE.)

LIFE-PRESERVERS, a term applied to certain arrangements for rendering the human body buoyant in the water. The weight of the human body is a little less than that of an equal bulk of water, so that it naturally floats in that liquid. When, however, a man floats on his back on the water, his mouth will most probably sink under the surface, unless he use some strong muscular effort, so as to throw the head back. It is a well-known fact, that many persons unable to swim, who fall into still water, might be saved, if they retained their presence of mind, so as to preserve a proper position. By attaching to the chest some buoyant substance, it becomes an easy matter to keep the upper part of the body above the surface of the water. The arrangements for effecting this purpose are not large in bulk, and are generally known by the name of life-preservers. They are principally made of cork, in the form of jackets and belts, or of India-rubber cloth belts or cylinders, which, when inflated, are able to sustain a person above the surface of the water. One of the best life-preservers is that of M. Scheffer. This invention consists of a hollow air-tight cylinder, made ready for use when distended with air. It may, perhaps, be more properly called a cylindrical ring, without a seam and without a break. The external diameter of this ring is about twenty-two inches, and the internal diameter about twelve, the diameter of the cylinder itself being about five and a half inches, but varying with the size of the person for whom it intended. It contains a small stop-cock, to which an ivory pipe is fixed. Air can be injected into the cylinder from the mouth by this pipe, and retained by means of the stop-cock; the whole inflation and arrangement can be completed in one minute. When uninflated, this life-preserver folds up into a very small compass; it can easily be carried in the pocket, and only weighs twelve ounces. There are many other varieties of life-preservers; but in general they closely resemble that of M. Scheffer. Of late years the term life-preserver has been applied to a small weapon, about a foot long, made of twisted whalebone, and heavily loaded at each end. Although originally intended for protection against attack, it seems to have become the special weapon of burglars and other ruffianly characters.

LIFE RENT, in Law, is a rent which a man receives for a term of life, or for the sustentation of it.

LIFTING, *lyft'-ing* (Swed. *lyfta*, to lift), on Easter holidays, is a custom which formerly prevailed throughout the country, and which still lingers in some of the more distant parts. On Easter Monday the women form parties of six or eight, and surround such of the opposite sex as they may meet, and with or without their consent, lift them thrice above their heads, with loud shouts at each elevation. On Easter Tuesday the men in similar parties do the same to the women. A small sum or fine is always extorted from the persons so lifted. This custom, it is said, is designed to commemorate our Saviour's resurrection.

LIGAMENT, *lig'-ă-ment* (Lat. *ligamentum*), in Anat., is a strong elastic membrane connecting the extremities of movable bones. They are divided into capsular and connective, the former surrounding the joints like a cap.

LIGAN, *li'-găn* (Fr. *lier*, to tie), in Law, is a wreck consisting of goods sunk in the sea, but tied to a cork or buoy in order to be found again.

LIGATURE, *lig'-ă-ture* (Lat. *ligatura*), in Surg., is applied to anything used in binding any part of the body. More particularly it is applied to the thread or silk used in the tying of arteries or veins that have been cut. In such cases, ligatures should admit of their being tied with some force without the risk of breaking.

LIGATURES, among printers, are types consisting of two or more characters joined together; as *ff*, *fi*, *fl*. The old editions of the Greek authors are extremely full of ligatures, and those of Stephens are very beautiful. Ligatures are little used in modern printing

LIGHT, *lite* (Sax. *licht*, *liht*), a term applied to the natural agent by which objects are rendered perceptible to the sense of seeing. The study of the nature and properties of light has been an object of philosophical disquisition from ancient times; but it must be acknowledged that the subject is as little understood at the present day as any of the most abstruse subjects of philosophical inquiry. Amongst the earliest speculations on the subject are those of Pythagoras, who considered that vision was caused by particles continually emanating from the surfaces of bodies and

entering the pupil of the eye. Plato and his followers, however, believed that vision was the result of the emission of particles from the eye meeting with certain emanations from the surfaces of things. Notwithstanding this improbable hypothesis, the Platonist seem to have detected several properties of light; such as its propagation in straight lines, and the equality of the angles of incidence and reflexion when it falls on a reflecting surface. The ancients were also acquainted with the fact that the sun's rays could be concentrated by means of a concave mirror. Light was regarded by Aristotle as a mere quality of matter, and Ptolemy the geographer wrote a treatise on optics, which has not been handed down. After this era of speculation, a long period of darkness occurred, till the Arabians began to cultivate the learning of the Greeks, and several of their philosophers treated of optics. The earliest Arabian work on this subject was written by Alhazen; it contains a description of the eye, and details many experiments on reflexion and the refracting power of air. The work of Alhazen was commented upon by Vitelio, a native of Poland, in 1270; and, from a passage in Roger Bacon's works, it would appear that spectacles were used about the same time. There is, however, no absolute certainty as to the discoverer of spectacles. After the revival of letters, Maurolycus of Messina, one of the earliest cultivators of mathematics, made optics his study. Baptista Porta, and afterwards Lord Bacon, also made light a subject of investigation. The latter philosopher complained that the *origin* and *form* of light had been too much neglected. Antonio, bishop of Spalatro, first gave the true theory of the rainbow. The next important step was the discovery of the telescope, by Zacchias Jansen, a spectacle-maker of Middelburg, in Walcheren, in 1590. This valuable invention was immediately applied, by Galileo, to physical astronomy with great success: in a short period of time he discovered by its means the satellites of Jupiter, the structure of the Milky Way, the phases of Venus, the spots on the sun's disc, and a number of stars hitherto unknown. The invention of the compound microscope seems also to belong to Jansen. After a number of philosophers had given their attention to the subject, the interesting discoveries of the century were crowned by the researches of Newton concerning the optical properties of light. Notwithstanding the brilliant discoveries that have been made in this branch of science, very little is known concerning the nature of light. Philosophers are agreed, in so far that they acknowledge that the phenomena of vision depend upon the agency of a subtile, extremely attenuated matter, set in motion by the sun and other luminous bodies. That it is material, is inferred from its deflection from its rectilinear course in passing near various bodies; from its being arrested by some substances, while it passes freely through others; from its capability of condensation and dispersion; from its producing chemical changes in certain compounds; and from its seemingly entering into the composition of certain substances, from which it can be again extracted. Thus far philosophers agree; but with regard to the propagation of light, and the mode in which it makes itself perceptible to our senses, there are two hypotheses,—the hypothesis of *emission*, and the hypothesis of *undulation*. The hypothesis of emission supposes that light consists of a highly attenuated fluid, the particles of which are not affected by gravity, but are endowed with a great self-repulsive force, and are actually projected from luminous substances in straight lines with inconceivable velocity. In the hypothesis of undulation, on the contrary, the whole universe, including the interstitial spaces of all matter, is conceived to be filled with a highly elastic rare medium, which possesses the property of inertia, but not gravitation, to which the name of *ether* has been given. This medium is not light, but light is produced in it, by the excitation, on the part of luminous bodies, of an undulatory motion, analogous to the waves of water. By this theory, luminous bodies are supposed to act on the universally diffused fluid somewhat in the same manner that sonorous bodies do on air in the production of sound. Whichever hypothesis be adopted, it seems that the propagation of light is a process of the most astonishing rapidity. It was observed by Rœmer that the eclipses of Jupiter's satellites happened sometimes sooner and sometimes later than the times given by the tables of them, and that the observation of them was before or after, according as the earth was nearer to, or farther from, Jupiter. It was therefore concluded that this circumstance depended upon the distance of Jupiter from the earth. Subsequent observations showed that planetary light requires about fourteen minutes to cross the earth's orbit. Whether light, therefore, be looked upon as an emanation or an undulation, it must be regarded as travelling with a velocity of 200,000 miles per second. The following extract from Sir J. Herschel's "Discourse" may give some conception of this velocity.—"A cannon-ball would require seventeen years, at least, to reach the sun, supposing its velocity to continue uniform from the moment of its discharge; yet light travels over the same space in seven minutes and a half. The swiftest bird, at its utmost speed, would require nearly three weeks to make the tour of the earth; light performs the same distance in much less time than is required for a single stroke of its wing." The origin of light, like that of heat, may be traced to various sources. The sun is not only the great fountain of heat, but also of light, which it imparts to the earth and to the other members of the solar system. Light emanates, also, from terrestrial matter in different states of activity. It is thrown off when certain homogeneous substances act upon one another by the mechanical force of friction, thus, when two pieces of quartz or rock-crystal, or two pieces of loaf-sugar, are rubbed together, they emit flashes of light in a dark place. Flashes of light have also been observed when bodies suddenly change their state under the force of crystallization. It is generated in still greater abundance when heterogeneous substances act upon one another under the force of chemical affinity. All the common means of artificial illumination by lamps, candles, and gas-lights, are dependent upon this action. When solid bodies are heated to a temperature of 800°, they begin to shine in the dark, and if a current of air at 900°, which is in itself non-luminous, be made to strike upon pieces of metal, earth, &c. it will speedily communicate to them the power of radiating light. The passage of electricity excites it with a degree of intensity only surpassed by that of the solar ray; while in the glow-worm and firefly we see that the processes of life are capable of evolving it. When bodies are in this state of activity, they are said to be self luminous; but by far the greatest number possess no such property at ordinary temperatures. Although unable to be luminous themselves, all substances are capable of becoming so when placed in the presence of a self-luminous body, since a process of secondary radiation commences from them. A lamp, for instance, brought into a dark room, is not only visible itself, but renders all the objects in the room visible. A sunbeam admitted into a dark chamber only renders luminous the objects directly in its course; but if any of these be white, as a sheet of paper, the whole apartment will become illuminated by this secondary radiation. Amongst the heavenly bodies this fact is illustrated on a splendid scale. The sun is the great self-luminous source of the system; the moon and the planets possess no such inherent property; but those parts of them on which the sun's light falls, become for the time luminous, and perform all the offices of self-luminous bodies. It is, therefore, evident that the communication which we call *light* not only subsists between luminous bodies and our eyes, but between luminous and non-luminous bodies, or between luminous bodies and each other. The investigation of the properties of light constitutes the peculiar province of optics. This science is completely mathematical (*see* OPTICS); but its basis, like that of all other branches of natural knowledge, must be experiment. The physiological relations of light will be found described in the article EYE; it is only further necessary to say here, that the radiant force produces the sensation of light by striking against the expanded nerve of vision,—the retina of the eye; and that the effect is persistent during a definite portion of time. Hence it is, that winking with the eyelids forms no impediment to correct vision. Experiment has also shown that the impression received by the mind lasts for about the eighth part of a second, but varies with

the intensity of the light; so that a luminous point, revolving with a velocity sufficient to complete a circle in that time, will not appear as a fiery point, but a fiery circle. One of the first relations of light to ponderable matter is, that most bodies possess the property of intercepting it in its progress, whilst a few allow it to traverse their substance. From this circumstance arises the distinction of bodies into opaque, transparent, and diaphanous. The light of the sun reaches us freely through a plate of glass, but is entirely excluded by a plate of metal. A sheet of white paper or a piece of porcelain also allows light to pass through it; but not in straight lines parallel to its first direction,—the rays become broken up, as it were, and radiated again from a new self-luminous centre. When an opaque screen is placed between a luminous body and another object, such as a sheet of paper, a shadow is cast which is similar in outline to the section of the body producing it: from this phenomenon we learn that the rays of light are transmitted in straight lines. When a pencil of light traverses space, or a perfectly homogeneous medium, its course is rectilinear and its velocity uniform; but when it encounters an obstacle or enters a different medium, it undergoes certain modifications; it separates itself into several portions: one of these is *reflected*, that is, turned aside, after which it pursues a course wholly exterior to the obstacle or new medium; a second portion enters the medium and is *refracted*, or bent out of its original direction; a third portion is *absorbed*, or lost; and a fourth portion is radiated, or repelled in all directions from the surface. In reflexion the primary law is, that the angle of incidence is equal to the angle of reflexion. It is thus that the images are formed in a looking-glass; and as we always see objects in the direction in which the ray of light arrives at the eye, we judge the image to be as much behind the surface of the glass as the object is before it. Every known substance, not excepting air, the most diaphanous of all, reflects some portion of light. It is calculated that if a person were plunged 150 feet in the clearest water, he would find the light of the sun no more than that of the moon. When objects are looked at through glass, they become more dim in exact proportion to its thickness. There is, indeed, no such thing in nature as perfect transparency. On the other hand, also, there is no substance possessing the property of perfect reflexion; a piece of leaf-gold held up between the eye and any strong light, permits bluish rays to pass through. Light may be so reflected from regular curved concave surfaces that all the rays may converge to a point or focus. In these cases the direction of each ray is the same as if it had been reflected at the point of incidence from a plane surface tangent to the curve. When a ray of light is admitted into a dark room, it may be almost wholly turned aside by reflexion from a metallic mirror in any direction, according to the angle at which the mirror is presented to it. If it be made to fall on any object, it will affect that object as the original ray, a portion of it becoming irregularly repelled or scattered. It is this portion which renders an object visible in all directions. When this scattered light falls upon other bodies, it is again reflected and dispersed from them, making them visible, but in a less degree, on account of the partial absorption which is continually taking place, and the whole apartment is lighted. If the ray falls on a sheet of white paper, the room will be well lighted, but if upon black velvet, the room will remain dark; since nearly the whole of the light will be absorbed. To ordinary vision this property is of the highest importance. All bodies on the earth possess it in various degrees, and the atmosphere which surrounds it, in a remarkable manner. The sun's light, by this means, is diffused, and that milder radiance maintained which is so agreeable to the eye, and which renders objects visible when the rays do not fall upon them. Without this property all objects shaded from the sun would be totally invisible, and without an atmosphere the sun would appear as a fiery disc in a black sky. Travellers state that on lofty mountains, where the atmosphere is rare, the sun's rays are painfully intense and the sky of the darkest blue, almost amounting to black. When a pencil of light, that is an assemblage of rays passing from a luminous point, falls on the surface of any transparent uncrystallized medium, a portion pursues its course through it. If it enters perpendicularly, it passes through in a straight line; if at an angle, it is bent from its course, and is said to be *refracted*. In refraction, each different medium has its own action on light; some turning a ray incident at a given angle more out of its way than others. As a general rule, the refractive power of substances is in some degree proportional to their densities: for instance, water acts more powerfully than air, and has its power increased by the solution of different salts; and glass, again, is superior to either. The effect of refraction is familiarly illustrated if a stick be held obliquely in water, when it appears bent at the point of immersion. The direction of a ray of refractive light depends not only upon the surface where it enters, but also at its point of exit. Thus, by modifying the surfaces of reflecting media, the rays of light transmitted can be diverted almost at pleasure. (*See* LENS.) Since the deflecting power acts at the surfaces of bodies, the original deviation of a ray entering a piece of glass may be doubled at its emergence by a proper adjustment of surfaces. In the case of a triangular prism, the light which falls upon one of the faces is refracted at the first surface, and also at the second, but the second refraction does not bring the ray into a direction parallel with the incident ray, as is the case when the surfaces of the glass are parallel, but they are bent permanently in another direction. If a pure ray of white light from the sun be admitted into a dark room through such a prism, instead of being refracted altogether and appearing still as a white ray, it is divided into several rays of very vivid colours. In this state it is said to be analyzed, or decomposed into its elementary rays. Seven distinct colours can be distinguished; namely, red, orange, yellow, green, blue, indigo, and violet. The red ray is the least bent, and the violet the most. If these coloured rays be again collected by refraction through a convex lens, or by reflexion from a concave mirror, they reproduce white light at the respective foci. The space illuminated and coloured by a pencil of rays from the sun thus analyzed is called the solar spectrum. (*See* SPECTRUM, SOLAR.) This analysis of white light, however, is not wholly dependent upon the refractive power of a transparent medium, but from an effect called *dispersion*. The mean refractive and dispersive powers of bodies are not proportional to each other. If a hollow glass prism be filled with oil of cassia, the spectrum produced will be two or three times longer than that of a solid glass prism. Different substances not only exhibit a difference of dispersive power generally upon all the rays of light, but are found to act unequally on the different rays. Thin plates or scales of different substances, or substances divided by fine regular lines, or consisting of minute fibres, have also the property of decomposing light which falls upon them; but the phenomena which they present are totally different, and depend upon different principles. The simplest case of this property occurs when a beam of divergent light enters a dark room by an aperture not more than $\frac{1}{40}$th part of an inch in diameter, and a thin rod such as a pin is placed in its course. On examining the shadow, fringes of coloured light will be found on both sides. (*See* DIFFRACTION OF THE RAYS OF LIGHT.) These fringes are caused by the *interference* of the rays bent into the shadow on one side of the body with the rays bent into the shadow on the other. Interference is accounted for by the undulatory hypothesis; and the alternate cessation and increase of sound produced by two musical notes nearly in unison, known by the name of *beats*, presents a marked analogy with the alternate luminous and black fringes arising from the interference of light. Thin plates of different substances, such as mica, produce similar phenomena of colour; and the same effects are seen in the splendid colours exhibited in soap bubbles, and also when a small quantity of oil is poured on the surface of water. The iridescent tints in mother-of-pearl, the beautiful and varied plumage of many birds, and the colour of many shells and fishes, are all dependent upon the same cause. The law of ordinary refraction is far from general. Rays of light, in traversing the larger number of crystallized bodies, are commonly split into two pencils: one of these, called the *ordinary ray*, follows

PLATE LXXX.—LIGHTHOUSE.

FIG. 3

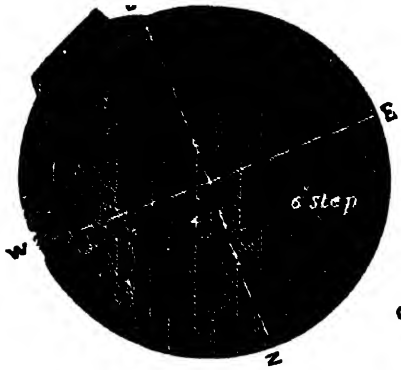


FIG. 4

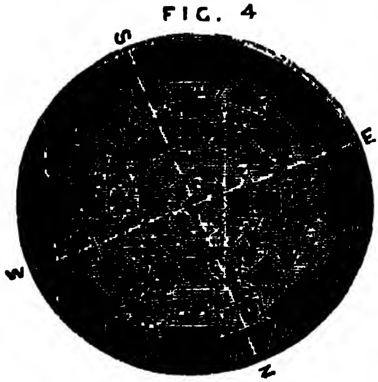


FIG. 1

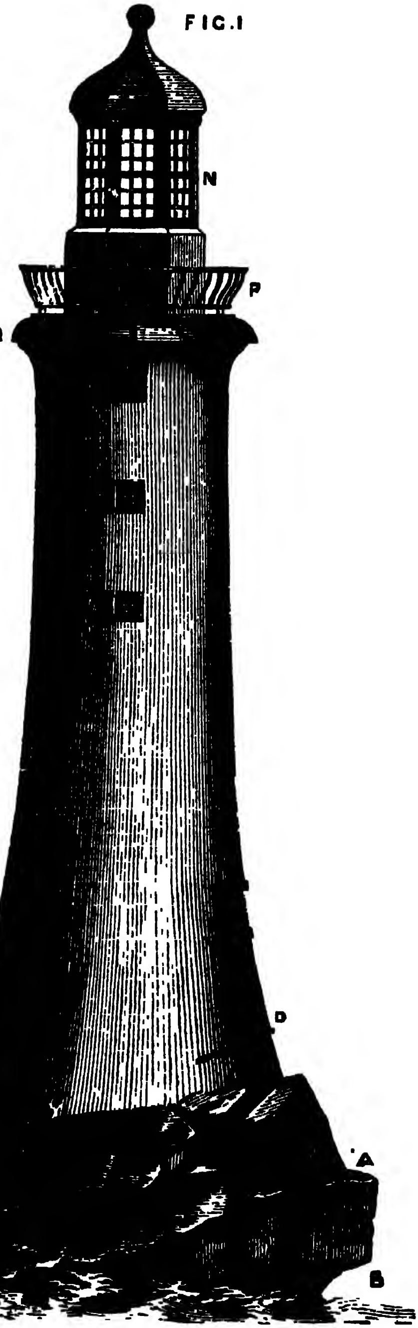
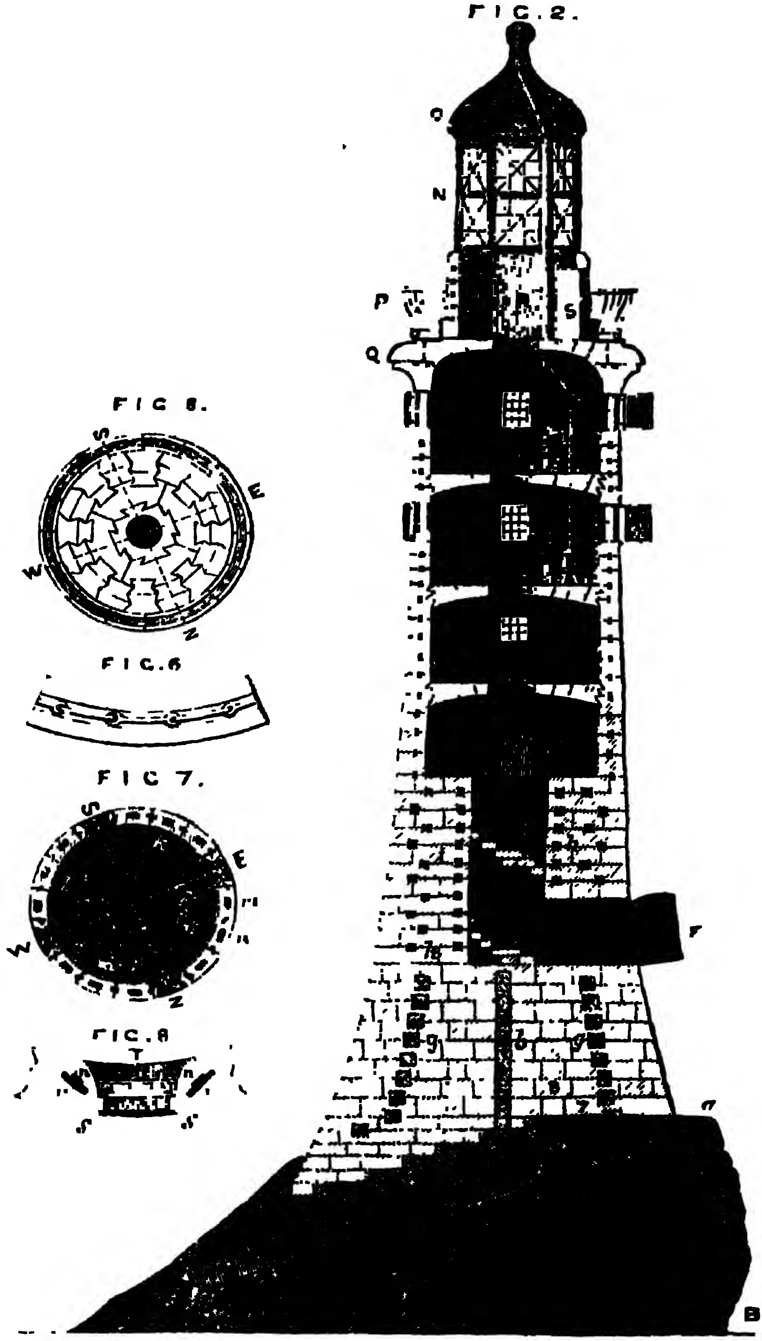


PLATE LXXXI.—LIGHTHOUSE.



the common laws of refraction; whilst the other, called the *extraordinary ray*, obeys very different laws. This phenomenon is observed in all crystallized bodies which do not belong to the tessular system, or that class which may be supposed to be constructed of spherical particles; such as the regular cube, octohedron, &c. According to the nature of the crystal, and the direction in which it is cut, the division of the beam is greater or less. The best exemplification of this mode of refraction is to be found in a substance called *Iceland spar*, the crystallized carbonate of lime. If a small illuminated object be looked at through a rhombohedron of this substance in certain positions, two images of the object will appear; and on turning the crystal round in its own plane, so as to make a complete revolution, the two images will assume a regular movement with regard to each other, and one will fall upon the other, or coincide with it, twice in the revolution. If the rays of light separated by passing through Iceland spar be passed through another crystal placed similarly to the first, no further subdivision of the light will take place. If, again, the crystals be so placed that the principal sections are at right angles, there will still be but two images; but the ordinary and extraordinary rays of the first will become reversed in the second: at all intermediate positions, however, there will be a subdivision of each ray, and, consequently, four images. Each ray has then suffered a physical change, which has been called *polarization*, a term which indicates, according to Dr. Whewell, "opposite properties in opposite directions, so exactly equal as to be capable of accurately neutralizing one another." Many crystallized minerals, when cut into parallel plates, are sufficiently transparent to allow of abundance of light to pass through them, which, in consequence, is found to be polarized. Through a well-polished plate of *tourmaline*, cut from a crystal of a brown colour, in a direction parallel to the axis of the prism, a candle may be seen as through a piece of coloured glass, and no change will be observed on turning it round. If another similar plate be interposed between the first plate and the eye, and made to revolve slowly in its own plane, the candle will appear and disappear alternately at every quarter revolution; passing through every degree of brightness, to total, or nearly total, evanescence, in each quadrant. If the rays separated by a crystal of Iceland spar be examined by means of a plate of tourmaline, it will be seen that the *ordinary* image is most intense when the axis of the tourmaline is perpendicular to the principal section of the rhombohedron, and that it becomes extinct in the opposite direction. When the axis of the tourmaline lies in the principal section itself, the *extraordinary* image presents similar phenomena. The polarization of a ray of light may also be effected by reflexion. When a ray of light falls upon a polished glass surface at an angle of 56° 45′, if the reflected ray be examined through a plate of tourmaline, it will exhibit the same series of phenomena as if it had passed through another plate of the same substance. The light is invisible when the axis of the tourmaline is parallel to the plane of reflexion. Different substances polarize light by reflexion at different angles: water at 53° 11′, and the diamond at 68° 1′. The most interesting, as well as the most splendid phenomena of polarized light, are the brilliant and gorgeous colours which, under certain conditions, are developed by crystallized plates. If a ray of light which has been polarized be made to traverse a thin plate of mica, or sulphate of lime, which is colourless to common light, and then examined through a plate of tourmaline in that position where, without the plate, it would disappear, the ray will be seen, but splendidly coloured with tints depending upon the thickness of the plate and its inclination. The polarisation of light has been made useful in detecting the nature of substances which elude the direct process of chemical examination, and also for the purpose of detecting rocks and shoals at the bottom of the sea. By viewing objects at the bottom of the sea through a polarizing tube, nearly the whole of the glare of the reflected light is extinguished. For many years it has been known that solar light is capable of producing powerful chemical changes. One of the most striking of these is its power of darkening the chloride of silver. This effect takes place slowly in diffused light, but very rapidly in the direct rays of the sun. It was at first thought that this effect was caused by the luminous rays; but through later observations it appears that solar light may be divided into three parts,—the light-giving rays, the heat-giving rays, and the chemical rays. It is by the latter rays that the salts of silver are decomposed. The greatest chemical action, it has been observed, takes place just beyond the violet rays of the spectrum, and the property gradually diminishes till the green division is reached; beyond which it does not exist. (*See* PHOTOGRAPHY.) Light is of great importance in the vegetable kingdom; when deprived of it, plants grow white and contain an excess of aqueous and saccharine particles. To the influence of the sun's rays, flowers owe all the variety, beauty, and intensity of their colours; and to man and all the superior animals, the light of the sun is necessary for life, health, and strength.

LIGHT, ABERRATION OF. (*See* ABERRATION.)

LIGHT-BALLS, in Mil., cases filled with a composition that ignites readily and burns with a brilliant flame, which are thrown from mortars to illumine any position in which a party of the enemy is supposed to be working. They are chiefly used by the besieged in order to discover the troops that are engaged in tracing and forming the trenches at the commencement of operations against a fortified town, and in case of an assault, when the balls are thrown by hand into the ditches on either side of the breach and on the débris of which it is composed, that the light proceeding from them may enable the defenders to direct a fire with precision against their assailants. The composition that is used consists of 10 parts of saltpetre to 3 of rosin and 4 of sulphur. These ingredients are first powdered and passed through a sieve, and then mixed into a stiff paste by the addition of a little boiling linseed oil. This is placed in a spherical case of cartridge-paper, or canvas made of gores sewn together, or in cylinders formed by two hemispherical ends of metal kept apart by a few strong wires fastened at either end to the r[illegible]ms of the metal cups, the framework thus formed being covered with canvas or stout paper. The case made in this manner is about half as long again as it happens to be in diameter, and the diameter varies in accordance with the calibre of the piece from which it is to be discharged. Either kind of case is filled with the composition through a hole made for the purpose, which also serves as a fuse-hole for the introduction of a piece of quick-match that ignites the mixture as soon as the case is discharged from the mortar. These cases are sometimes filled with a composition that emits a dense smoke when it is set alight. They are then used to mask the operations of troops, or to compel men who are working in the galleries of mines to abandon them in order to escape suffocation from the smoke and stifling odour that issues from them. The composition that is used in making these consists of 10 parts of mealed powder, 2 of saltpetre, 3 of coal-dust, 4 of pitch, and 1 of tallow. The powder, saltpetre, and coal-dust are pulverized and sifted, after which they are mixed with the pitch and tallow in a melted state.

LIGHT CAVALRY. (*See* CAVALRY.)

LIGHTER is a large, open, flat-bottomed vessel, employed to carry goods to or from a ship.

LIGHTHOUSE, a building erected on any part of the coast, or on islands at a little distance from it, to enable the sailor to determine the position of his vessel when it is approaching land at night, and to shape his course so that he may avoid any dangerous shoals, reefs, or headlands that may lie in its vicinity. Lighthouses are generally built in the form of a cylindrical tower, the lower chambers of which often afford accommodation for the keeper of the light and his family, while the uppermost story constitutes a gigantic lantern; being a room with glazed sides, and having a lamp in the centre. This is lighted at nightfall by the keeper, and burns with a brilliant flame, the light of which is reflected seawards for some miles by the aid of a combination of highly-polished reflectors. There is generally some peculiarity in the appearance of the light shown by every lighthouse, which enables it to be readily identified,—in some a steady light is exhibited, which may be made to appear to be coloured by transmitting it through coloured glass; while in others the light is intermittent, the light appearing at certain in-

tervals of longer or shorter duration, or a flash of one colour being sometimes succeeded by a flash of another colour. The obscuration of the light for any fixed interval of time, or a change of colour, is effected by bringing an opaque screen, or screen of coloured glass, before the lamp and withdrawing it successively; the revolution of the screen or coloured medium being effected by machinery which is attached to it, and which is similar in its nature to clock-work. In places where the navigation is intricate on account of sandbanks and shoals, as it is at the entrance to any large tidal rivers, vessels are moored in the necessary positions on which the lights are displayed. The best-known light of this description is the floating light off the Nore; but they are to be found in the Mersey, off Liverpool, and other rivers; while lighthouses, among which the Start lighthouse, on Start Point, Devon, and the Eddystone (*see* EDDYSTONE LIGHTHOUSE), may be specially named, appear on almost all the principal headlands of the United Kingdom. All beacons and buoys laid down to mark out certain channels for the guidance of mariners, and all lighthouses and floating lights, belong to, and are under the management of, the Trinity Board. (*See* [illegible] structions respecting the peculiar way in which the light is exhibited from any lighthouse or floating light, and its bearings with regard to other parts of the coast and headlands in its immediate vicinity, that the captain or master may be enabled to recognize the light, and so determine the position of his vessel. The erection of any new light or beacon, and any changes with regard to those that have already been in operation, are duly notified by the Trinity Board in the advertising columns of the *Shipping Gazette* and principal daily London papers. The Skerryvore rocks, about twelve miles south-west of Tyree, on the coast of Argyleshire, lying in the track of the shipping of Liverpool and the Clyde, had long been regarded with dread by the mariners frequenting those seas. The extreme difficulty of the position, exposed to the unbroken force of the Atlantic Ocean, had alone deterred the Commissioners of Northern Lights from the attempt to place a light upon this dangerous spot; but in 1834 they caused the reef to be surveyed, and in 1838 Mr. Alan Stevenson commenced his operations upon a site from which nothing could be seen for miles around but white foaming breakers, and nothing could be heard but the howling of the winds and the lashing of the waves. His design was an adaptation of Smeaton's tower of the Eddystone to the peculiar situation. He established a circular base 42 feet in diameter, rising in a solid mass of gneiss or granite, but diminishing in diameter to the height of 26 feet, and presenting an even concave surface all round to the action of the waves. Immediately above this level the walls are about 9½ feet thick, diminishing in thickness as the tower rises to its highest elevation, where the walls are reduced to two feet in thickness, and the diameter to 16 feet. The tower is built of granite, and its height from the base is 138 feet 6 inches. In the intervals left by the thickness of the walls are the stairs, a space for the necessary supply of stores, and a not uncomfortable habitation for three attendants. The light of the Skerryvore is revolving, and is produced by the revolution of the light of eight annular lenses around a central lamp, and belongs to the first system of dioptric lights, according to Fresnel. The light may be seen from a vessel's deck at a distance of eighteen miles. Another notable lighthouse structure is the Bell Rock lighthouse, on the east coast of Scotland. This rock is situated in the German Ocean, eleven miles from the Scottish coast, on the north side of the Frith of Forth, and nearly opposite that of Tay. It is about 427 feet long and 230 feet broad, but the vicinity is dangerous over an area of 1,400 by 300 feet. The rock is a reddish sandstone, and the part upon which the lighthouse is built is twelve feet below high water. The lighthouse is built principally of sandstone obtained on the neighbouring mainland. The outer casing of the lowest 30 feet of the structure is of granite. It was commenced in 1807, and finished in 1810. The designers were Messrs. Rennie and Robert Stevenson. The difficulties overcome in the erection of this lighthouse were nearly as great as those encountered in the Eddystone; but an advantage was gained in the large size of the rock. The form is similar to that of the Eddystone. The diameter of the bottom course is 42 feet, and that of the course just below the cornice 15 feet. The stonework is 102 feet high.—(*Ref.* Ure's *Dict.*; *Jurors' Report of Great Exhibition of* 1851; *English Cyclopædia*.) Fig. 1, Plate LXXX., exhibits a south elevation of the Eddystone lighthouse. A represents the landing-place; B a natural cave in the east side of the rock; D an iron rod to serve as a rail to afford support in passing up steps cut in the rock to the foot of the ladder, occasionally put out from the entry-door at E; at F is a cascade of water pouring over a low part of the rock. In fig. 2, Plate LXXXI., *a* B shows the upright face of the rock, and the line *a b* the general direction of its line or slope. In this figure it is seen that as high as the first fourteen courses of stonework the building is entirely solid. Here the entry F commences; but excepting this opening and the staircase X, the solid still continues to the floor of the lowest chamber, G, which is the store-room, and H the door at which the stores are drawn up and received; I is the upper store-room; K the kitchen, [illegible] carried off by a copper funnel (*m*) through the bedroom M and lantern N to the ball on the top of the cupola O. The ascent from room to room is by the perforation through the middle of each floor, a movable step-ladder being used by the attendants; P is the railing forming the balcony; its floor is covered with very thick sheet-lead, turned down over the cornice Q, which surmounts the column of the building; R is the stone basement of the lantern, and U the glazed part. The cupola O is supported by eight cast-iron standards, between which the copper window-frames are fixed; these standards have claws at the bottom, which are screwed to flat iron bars resting upon the stonework. By this means the whole lantern is framed together, and to strengthen it, the window-frames are cast with diagonal bars, as shown in fig. 2. The whole lantern is held down by eight bolts at its angles, passing down through the balcony floor; one of these is seen at *d*. S is the door to the balcony. The section of the building as shown at fig. 2, Plate LXXXI., shows the several slips which were cut in the rock to engraft the stonework upon. Figs. 1, 2, 3, &c., at the base of fig. 2, Plate LXXXI., denote the different courses of stone, each of which makes a level with the step into which it is fitted. The seventh is the first complete course. Fig. 3, Plate LXXX. is a plan of the rock, showing the courses 1, 2, 3, laid in their places, and exhibiting the dovetails which are cut in each slip to hold the several stones in their places; and these stones are so formed as to inlock the others with them in a manner which prevents any from quitting its place. The dark-shaded stones are Moor stones, while the lighter sort are Portland stone. Fig. 4, Plate LXXX., is a plan of the seventh or first complete course, showing a central stone with four dovetails uniting it to four others, and these tying in with the remainder. All the solid courses are laid in this manner to the fourteenth, which, as before mentioned, completes the entire solid. Every course is laid in such a manner upon the one beneath it that all the joints break each other, as the masons term it; that is to say, immediately above and below the joints in any course the middle of a solid stone is disposed. The several courses are retained upon each other, to prevent their sliding sideways, by means of *joggles*, which are plugs or cubes of hard black marble, shown by the dark squares at the base of fig. 2, Plate LXXXI., and in the plan, fig. 4, Plate LXXX., to be received one-half through every two adjacent courses. All the courses of the entire solid have a central *joggle* (*f*) and eight others (*g*) arranged on a circle round it, as shown in fig. 4. Above the entire solid the central stone is omitted, to leave the well-hole for the staircase X, or rather, it is composed of four stones united by hook or dovetail joints, to form when put together one piece large enough to have the well-hole through its centre, the exterior stones being united to it as a central piece in the same manner as in fig. 4. In these courses the continuity of the blocks being somewhat broken, double the number of *joggles b*, and these half the size, are introduced between the courses.

It is to be observed that none of the joggles, except the central ones, come immediately over the others, as the figure would infer, but they break joint with each other to give every part of the solid an equal strength. Above the solid a new system of building was necessarily adopted. The lower courses were composed of blocks of Portland stone to fill up the centre, and Moor stone, as being more durable, to construct the exterior. The whole of the upper work is of Moor stone; and dovetailing being no longer practicable, the stones are united by iron cramps and joggles, as shown in fig. 7, which is a plan of the upper, or bed room, M. Each block of stone is here seen to have an iron cramp to bind it to its neighbour, and a small marble joggle to unite it with that above it. The vertical joints are rendered impervious to water by cutting a notch between every two adjacent blocks, so that when they come together it forms a hole of lozenge shape, and a piece of stone being placed in this hole with mortar, makes a perfect joint, whilst at the same time it increases the bond of the blocks of stone. This kind of joint is partly seen in fig. 8 at *n*, but one half is hid by the iron cramps *r*, *r*, extending over every joint. In the drawing they are seen inclined, that they may take firmer hold of the blocks *s*, *s*. The blocks of the different floors are dovetailed together, as in figs. 5 and 7, and are rather arched on the lower side, as shown in fig. 2. To retain the thrust of these arches, every course from which a floor springs is bound by an endless chain inlaid in the stonework, as in fig. 5, and run in solid with lead. The chain is seen enlarged in fig. 6; fig. 7 is a plan of the bedroom M, showing the disposition of the cabin beds *k*, *l*, *m*, with a window between each. The dark spot *m* is the smoke-funnel, and *n* the place for a clock.

LIGHT INFANTRY. (*See* INFANTRY.)

LIGHTING AND WATCHING.—By 11 Geo. IV. c. 27, provision was made for the lighting and watching of parishes in England and Wales. It was repealed by 3 & 4 Will. IV. c. 90, which enacts that, on the application of three rated inhabitants, the churchwardens of any parish are to convene a meeting of the ratepayers to determine whether the provisions of the act shall be adopted; and the majority in favour of the adoption must consist of two-thirds of the votes of the ratepayers. In the event of their adoption, inspectors are to be appointed for carrying them into effect. The power to raise rates under 3 & 4 Will. IV. c. 90, and under local acts, to cease where districts are taken under the care of county and district constabulary force, by 3 & 4 Vict. c. 88; and the powers, property, and liabilities of trustees for paving, lighting, &c., may be transferred to the body corporate of incorporated towns, under 20 & 21 Vict. c. 50.

LIGHTNING, *lite'-ning* (Ang.-Sax.), a sudden discharge of electricity from one cloud to another, or from a cloud to the earth, or from the earth to a cloud; producing a vivid flash of light, accompanied generally by a loud report, called thunder. When a thunder-storm commences, light clouds with jagged edges are observed, the motions of which are often opposite and variable. At the surface of the earth, the atmosphere is still and calm, with a slight elevation of temperature and considerable barometric and hygrometric changes; producing sensations of closeness, faintness, and oppression. Low murmurings of distant thunder are then heard, after which the lower region of the air is refreshed by cooler, but light breezes of uncertain direction. The thunder-clouds appear nearer, larger, and blacker, and the sensations of uneasiness increase. At short intervals, flashes of lightning are observed. Their course is sometimes zigzag, when it is called *forked lightning*: the breaking up of its course shows that it is dangerous, since the lightning must be near terrestrial objects. After the discharge, heavy showers of hail or rain descend, and the atmosphere is again cooled. The blackness then becomes universal, and the thunder is heard in a loud burst, almost instantaneously with each brilliant flash of lightning. The colour of lightning varies, being generally a changeable yellow, and sometimes red, blue, or violet, according to the density of the atmosphere. The identity of lightning with the discharge of ordinary electricity was discovered by Benjamin Franklin in America, and Romas in France. Franklin, in June, 1752, having perceived a thunder-cloud approaching, sent up a silk kite attached to a dry hempen cord. Soon afterwards he noticed that the loose threads of the cord stood erect, and upon approaching his finger to the cord, he drew sparks. A little rain falling, the conducting power of the cord was increased, and the violence of the shocks received from the sparks warned him that it was dangerous to continue the experiment. The experiments were repeated in Europe, and atmospheric electricity became a favourite study, till it was checked by the death of Professor Richmann, of St. Petersburg. He had attached a simple species of electrometer to his apparatus for measuring the intensity of the electricity in a thunder-cloud. After a loud clap of thunder, he proceeded to read off the degree indicated by his instrument, when a globe of electric fire was discharged through his body, and killed him on the spot. The causes which produce atmospheric electricity are not well known. In general, when a flash of lightning occurs, the earth and the cloud may be looked upon as the terminal planes of a highly-charged system of di-electric air, the tension of which goes on increasing until any further increase causes it to give way, when the opposite electricities rush together with violence, producing equilibrium by disruptive discharge, or a flash of lightning. There are several varieties of lightning, known by different names.—*Forked lightning*, the only kind probably that strikes terrestrial objects, frequently divides into two or more zigzag ribbons or lines of light. When forming a long rippling line of light, it is called by the sailors *chain lightning*.—*Sheet lightning* seems to be spread over an immense surface, and varies in colour, being often red, but sometimes blue and violet. When lightning of this kind appears without thunder, it is called *summer lightning*, and is generally considered to be the reflexion of some very far-distant storm.—*Globular lightning* appears like a luminous ball or globe of fire, and travels comparatively slowly, while those mentioned previously are almost instantaneous. This variety of lightning, in a milder form, is known to the French and Spaniards as St. Elmo's fire; to the Italians as the fires of St. Peter and St. Nicholas; and to the Portuguese as corpos santos, which has been corrupted by English sailors into *comazants*. In this form it appears as tufts of fire on the top of ships' masts, the tips of bayonets, on the alpen-stocks of Alpine travellers, or on the tips of the outspread fingers, when the atmosphere is in a peculiar state of electrical excitement. When lightning strikes the earth, it has generally been remarked that the flash is succeeded by a suffocating odour, often compared to that of burning sulphur. To others, the odour appears to resemble that of phosphorus or nitrous acid. It seems probable that the smell is in reality due to the presence of ozone, generated by the action of the electric fluid on the air. One of the commonest effects of lightning is the fusion of metals. There is an instance on record of an iron chain being converted into a solid rod by the passage through its length of a flash of lightning. It has also been known to fuse sand and other silicious minerals into a kind of glass or enamel. When solid imperfect conductors are struck by lightning, they are torn and scattered to pieces. The masts of ships have in this way been shattered to fragments in an instant. Lightning is very fatal to human life. Between 1835 and 1852, no less than 1,308 persons were killed by lightning in France. In all cases, accidents from lightning are more frequent in elevated situations than in the plains, and in villages in the open country than in populous cities. When lightning strikes any person, it is particularly attracted by any metal that may be worn at the time. The best place for timid persons, who may be in a house unprotected by a lightning conductor, is the middle of the room, and at a distance from all walls, and especially from the fire and chimney.

LIGHTNING CONDUCTOR, a bar of metal, or a collection of bars of metal, attached in a particular manner to a building or a ship, and extending from below the level of the ground, from below the sheathing of the ship, to a point several feet above the highest part of the building or ship. The object of these contrivances is to conduct the electric fluid to the earth without doing any damage. (*See* CONDUCTORS and NON-CONDUCTORS OF ELECTRICITY.)

LIGHTS, FLOATING. (*See* LIGHTHOUSE.)

LIGHTS, NORTHERN. (*See* AURORA BOREALIS.)

LIGNIN, *lig'-nin* (Lat. *lignum*, wood), the incrusting matter contained within the cellular tissue, giving hardness to the wood and other parts of plants. At one time it was supposed that lignin was a true chemical principle; but the researches of Payen and others prove that it is not always constant in composition. It is, however, always characterized by being soluble in weak alkalies and insoluble in water.

LIGNITE, *lig'-nite* (Lat. *lignum*, wood), fossil wood, more or less mineralized and converted into coal. The lignites are generally dark brown, and woody in their structure. They are distinguished from true coal by burning with little flame and much smoke, owing to their containing a smaller proportion of carbon. The brown coal of Germany, which belongs to the tertiary formation, is much used as a source of paraffin and paraffin oils.

LIGNUM VITÆ. (*See* GUAIACUM.)

LILAC. (*See* SYRINGA.)

LILIACEÆ, *lil-e-ai'-se-e* (Lat. *lilium*, the lily), in Bot., the Lily fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*. Herbs, shrubs, or trees, with bulbs, rhizomes, tuberous or fibrous roots, and parallel-veined, sessile, or sheathing leaves. Flowers regular; perianth green or petaloid, inferior, 6-leaved, or 6-parted; stamens 6, inserted in the perianth or rarely into the thalamus; anthers introrse; ovary superior, 3-celled; style 1; stigma simple, or 3-lobed. Fruit a loculicidal capsule, or succulent and indehiscent, 3-celled. Seeds with fleshy albumen, numerous. The *Liliaceæ* are widely distributed throughout the temperate, warm, and tropical regions of the globe. There are 147 genera, and about 1,200 species. Among the useful plants of this order are the onion, leek, asparagus, squill, and aloe; and among the valuable products yielded by them are fibres, used for twine and cordage, edible seeds, and balsamic resins.

LILIUM, *lil'-e-um* (Lat.), in Bot., the Lily, the typ. gen. of the nat. ord. *Liliaceæ*. *L. candidum*, the white lily, has always been considered the emblem of purity, and this and many other species form beautiful border flowers. *L. Martagon* and its varieties are known as Turk's-cap lilies, from the turban-like form of their flowers. The bulbs of some species, as those of *L. tenuifolium*, *kamschaticum*, and *spectabile*, are commonly eaten in Siberia.

LIMB, in Astron., the name given to the border or edge of the disc of the moon or any planet, and also further applied to the edges of circles that form part of any astronomical instrument. The term is used more particularly in reference to the moon in descriptions of lunar eclipses.

LIMBO, *lim'-bo* (Lat. *limbus*, edge or border), in Roman Catholic Theol., signifies a place on the borders of hell. The *limbus patrum*, which is also called the *sinus Abrahæ* (Abraham's bosom), is the place on the borders of hell where the patriarchs and other good men who lived before the time of Christ remained, and who were set free by Christ when he descended into hell, and admitted into heaven; and since that time this limbo has remained closed and unoccupied. Some theologians also adopt another limbo (*limbus infantum*), where those infants who die without being baptized are confined. Dante describes the limbo in which he met with the distinguished spirits of pagan antiquity as the outermost circle of hell. Milton's limbo,—"large and round, since called the paradise of fools, to few unknown,"—is borrowed from the *limbus fatuorum* of the scholastic theologians. Limbo is now commonly used figuratively to denote any place of confinement or restraint.

LIME, *lime* (Sax. *lim*, *lime*), in Agr. and Build., a substance termed in Chem. oxide of calcium (*see* CALCIUM); which is used in the former as a manure, and in the latter as the principal ingredient in making mortar, by means of which stones and bricks are bound together in a compact and solid mass. It is also used in making plaster and cement for giving a smooth and uniform surface to the walls of buildings, internally and externally. It is obtained by burning limestone, chalk, marble, or any stone which contains carbonate of lime, in kilns, in order to produce calcination. The process of burning expels the water and carbonic acid gas from the stone, which falls to pieces on exposure to the air after removal from the kiln, and crumbles into a white flaky powder, which is called quicklime, and is possessed of highly caustic properties. When it is required for building purposes, it is slaked, as it is technically termed, or caused to go to pieces by throwing as much water upon it as it will imbibe, and allowing it to remain in the air for a considerable period. This treatment destroys its caustic properties in a great measure, and it is then known as slaked lime. Limes are divided into three classes, and distinguished as rich, poor, or hydraulic, according to the constituents of the various limestones from which they are produced. Rich limes contain very little silicate of lime in proportion to pure carbonate of lime, being composed of about 1 part of the former to 19 parts of the latter. They are so called because the stones from which they are procured imbibe a considerable quantity of water when they are slaked after calcination, and consequently increase to a great extent both in bulk and weight. The mortar made from limes of this description never becomes thoroughly hard; and they should not therefore be used in making mortar or plaster which is likely to be exposed to the action of the weather. They are, however, well suited for making plaster for the internal surfaces of walls and for manures. Chalk affords a lime of the purest and richest kind after calcination. The poor limes, of which class the lime produced from oolitic limestones is a fair specimen, are obtained from stones which contain a large per-centage of metallic oxides and insoluble flinty grit, and are so called because they do not increase in volume to any extent when they are slaked. They are similar to hydraulic limes in this respect, but they are distinguished from them in not possessing the property of setting or hardening rapidly under water, which is an eminent characteristic of the hydraulic limes. The limestones from which hydraulic limes are made, such as the blue lias and greystone lime, are those which contain a quantity of silicate of alumina in conjunction with pure carbonate of lime. When water is mixed with hydraulic lime after calcination, hydrated silicate of lime and alumina is formed, which gives the mortar thus made the power of hardening under water and resisting its influence. The hydraulic limes are classed according to the proportion of silicate of alumina that they contain; limes which contain 1 part of silicate of alumina to 2 or 3 parts of carbonate of lime being termed eminently hydraulic, as they are most capable of resisting the action of water; while those which contain a less proportion of silicate of alumina are known as hydraulic and moderately-hydraulic limes. The best limes, however, for resisting the action of water are those which are made artificially by burning clay which contains soluble silicate of alumina and pure carbonate of lime together. (*See* CEMENT.) Rich lime, or pure carbonate of lime, when mixed with a quantity of water, forms an opaque white fluid termed whitewash, used for coating the walls of houses within and without. Coloured washes may be produced by the addition of any coloured earth, such as red and yellow ochre. A little glue or size should be added to the whitewash or wash of any colour, to bind it and cause it to adhere to the walls without coming off on anything that may touch them. Lime is also valuable as a disinfectant, and is used in tanning for removing the hair from the skins of animals that are to be converted into leather.

LIME (Fr. *lime*), the fruit of *Citrus limetta*. It is imported into this country in a preserved state for use as a dessert. Its juice is also largely imported for the preparation of citric acid, and for the prevention of scurvy on board ship. (*See* CITRUS.)

LIME, CHLORIDE OF. (*See* CALCIUM, CHLORIDE OF.)

LIMEKILN, *lime'-kil* (Sax. *cyln*, from *cylene*, a furnace), the pit or species of oven in which limestones are burnt or calcined in order to obtain lime for building and other purposes. Limekilns are built of brick, with an interior lining of fire-bricks or of hard stone, that is calculated to resist the action of fire for a long period of time. When the fuel that is used in burning the limestone is placed in a mass by itself at the bottom of the kiln, and the stone above it, the kiln is termed an intermittent-kiln, as the fire must be let out and the

kiln cooled before the lime can be withdrawn. Kilns of this description are square or cylindrical in shape, while running kilns are in the form of an inverted cone or funnel, the diameter of the pit being larger at the top than at the bottom. They are so called because the fuel and limestone are thrown in in alternate layers, and the lime is withdrawn from the bottom of the pit as it is burnt, so that the operation of burning can be kept up for some time by throwing in fresh limestone and fresh fuel at the top as the lime is taken out at the bottom. Either wood, peat, or coal, may be used for burning lime in an intermittent kiln; but only coal can be used in a running kiln. It appears that when limestone is burnt in a running kiln, less coal in proportion is required to effect the process of calcination than when it is burnt in an intermittent kiln. On approaching a limekiln when alight, a shimmering vapour will be seen ascending from the top of the pit, which is carbonic acid gas disengaged from the stone while burning. (*See* KILN.)

LIME-LIGHT. (*See* DRUMMOND LIGHT.)

LIMESTONE, a general term applied to a great variety of rocks which contain a certain quantity of lime. Chalk is an earthy, massive, opaque variety, generally soft and without lustre. (*See* CHALK.) In nature, carbonate of lime is found more or less pure, both perfectly crystallized, as in calc-spar and arragonite; imperfectly, as in granular limestone; and in compact masses, as in common limestone, chalk, &c. Concretionary limestone, generally called stalactitic carbonate of lime, is formed by the filtration of water through rocks containing lime, which is dissolved out; and as the water drips slowly out in cavernous recesses, it parts with its carbonate of lime, which is deposited in zones, more or less undulated, which have a fibrous structure. These fibres are very beautifully shown in the long fibrous pieces called stalactites. The stratified variety called stalagmites shows a similar structure, varied only by the circumstances under which it was produced.—*Incrusting concretionary limestone* is similar to the above. It is found in calcareous springs, which are common in Derbyshire, Yorkshire, and other places. It is a common practice to place vegetable substances in these springs, when they become incrusted with carbonate of lime, and present all the appearance of fossils. There are several remarkable wells of this kind in volcanic districts, in some of which the water flows in almost a boiling state.—*Spongy limestone* is found at the bottom of those lakes the water of which is impregnated with lime.—*Travertino* was a limestone deposited by the waters of the Anio and the Solfaterra of Tivoli. Most of the monuments of ancient Rome were constructed of it.—*Compact limestone* has a close texture, usually an even surface of fracture, and dull shades of colour.—*Granular limestone* includes statuary and architectural marble, and has a texture somewhat resembling that of loaf-sugar. (*See* MARBLE.)—*Oolite* consists of rounded particles of limestone like the roe or eggs of a fish. Coarse lias is sometimes called *Coarse-grained limestone*.—*Marly limestone* is found in lake and fresh-water formations; its texture is fine-grained, its colour is white or pale yellow, and it is apt to crumble in the air. *Silicious limestone* is a combination of silica and carbonate of lime; and *stinkstone* is a carbonate of lime combined with sulphur and organic matter, which emits the smell of sulphuretted hydrogen when struck or rubbed. It is found in Derbyshire, Sutherlandshire, and some parts of Ireland. All limestones seem to have been the result of deposition effected by chemical changes. The vast space of time required to accumulate the great limestone ranges of this country cannot be estimated.

LIME-TREE. (*See* TILIA.)

LIME-WATER. (*See* CALCIUM.)

LIMITATION, *lim-e-tai'-shun* (Lat. *limitatio*), in Law, is a certain time assigned by statute within which an action must be brought, or other legal act done. In Scotland it is termed prescription. The use of these statutes of limitation is to preserve the peace of the kingdom, and to prevent those innumerable perjuries which might ensue if a man were allowed to bring an action for an injury committed at any distance of time. There is also the danger to the defendant that, if an action be long delayed, the documentary or other evidence of his rights may have been lost or destroyed; and also the hardship of finding himself suddenly deprived of what he had long had in possession. The limitation of actions naturally divides itself into two classes,—those which relate to the recovery of things real, and those which relate to the recovery of other things than real. It was in reference to real actions that the law of limitations was first established; and, originally, such actions were limited from some particular event or fixed era, as by the statute of Merton (20 Hen. III. c. 8), the demandant in a writ of right could not claim upon any seisin earlier than the reign of Henry II., nor by the statute of Westminster the first (3 Edw. I. c. 39), earlier than that of Richard I. At length, the Statute of Limitation (32 Hen. VIII. c. 33) was passed, which limited real actions, not from any fixed date or event, but a fixed period of time. It provided that where, in any writ of right or action possessory, the demandant claimed upon his own seisin, the seisin must be within thirty years; where on the seisin of his ancestor in a writ of right, it must be within sixty, in a possessory action, within fifty years. By 21 Jac. I. c. 16, it was enacted that all writs of formedon should be brought within twenty years after the title and cause of action first descended or fallen; and also that no person should make entry into any lands or hereditaments but within twenty years after his right should first accrue. By this act the time of limitation, as applicable to the crown, was extended to sixty years precedent,—namely, to 19th February, 1623; a period which, in course of time, became actually no limitation at all; and hence, by 9 Geo. III. c. 16, the period of sixty years was fixed within which an action must be brought. By 3 & 4 Will. IV. c. 27, entitled "An act for the limitation of actions and suits relating to real property, and for simplifying the remedies for trying the rights thereto," a variety of most important changes have been introduced. In general, twenty years is fixed upon as the time for the recovery of corporeal hereditaments, provided the claimant labour under no disability to assert his pretensions; and real actions are, with one or two exceptions, abolished, so as to leave parties deprived of land no remedy in general but those of entry or ejectment. This statute now governs the law of limitation in all proceedings to which the crown, if not a party (the limitation of sixty years being, as regards it, still in force), whether at law or in equity, for the recovery of things real, or of money secured or charged upon the realty. It provides that no person shall, after 31st December, 1833, make an entry or distress, or bring an action to recover any land, rent, or annuities charged upon land, &c., but within twenty years next after the time that the right of such action shall first accrue; but where the claimant labours under disability, as of infancy, lunacy, absence beyond the seas, &c., then within ten years next after such disability shall cease, or the person die, whichever shall first happen; but in no case shall the right of entry, &c., extend to forty years, even though the claimant may have remained during the whole of that time under disability. Except in cases of fraud, and certain others, no person claiming any land or rent in equity shall bring any action to recover the same but within the period during which he might have made an entry of distress, or brought an action of recovery, if his estate had been legal instead of equitable. Neither shall any action, suit, or other proceeding, be brought to recover any sum of money secured by any mortgage, judgment, or lien, or otherwise charged upon, or made payable out of, any land or rent, at law or in equity, or to recover any legacy, except within twenty years next after a present right to receive the same shall have accrued to some person capable of giving a discharge for the same, unless in the mean time some interest or acknowledgment shall be paid or made by the party indebted, to the creditor or his agent, in which case the twenty years are reckoned from the last of such payments or acknowledgments. No arrears of dower, or of damages on account of such arrears, and no arrears of rent or interest, shall be recoverable for a longer period than six years. With respect to actions not brought for the recovery of things real, it was enacted that all actions, suits, bills, indictments, or information upon any penal statutes, where any forfeiture is to the crown alone, shall be sued within two years from the

commission of the offence; where to a common informer alone, then within one year; where to both jointly, then by the common informer within one year, and by the crown within two years after that one year is expired. By 3 & 4 Will. IV. c. 42, all actions for penalties, damages, or sums of money, given to the party aggrieved, by any statute, must be commenced and sued within two years after the offence shall have been committed. By 11 & 12 Vict. c. 43, it is provided that all informations for offences punishable on summary conviction shall be laid within six calendar months of the offence, unless otherwise specially limited; and by 11 & 12 Vict. c. 44, no action can be brought against any justice of the peace for anything done in the execution of his office, unless within six calendar months from the offence. Several statutes limit the time within which actions may be brought against officers of excise, customs, &c., for acts done in the performance of their duties, to different periods, but in no case exceeding six months. By 21 Jac. I. c. 16, it is enacted that all actions of trespass for injuries to person, land, or personal property,—all actions of detenue, trover, replevin, account (except such as concern the trade of merchandise),—all actions of debt grounded upon any lending or contract without specialty,—all actions for arrears of rent,—shall be limited to six years; actions of trespass, menace, battery, wounding, and imprisonment, to four years; and actions on the case for verbal slander to two years. An exception, however, is made in favour of such persons as labour under disabilities; the limitation counting from the time when such disabilities are removed. By 3 & 4 Will. IV. c. 42, it is provided that all actions of debt for rent upon an indenture of demise, all actions of covenant or debt upon any bond or other specialty, all actions of debt or *scire facias* upon any recognizance, must be commenced within twenty years after the cause of such actions or suits shall have arisen; all actions of debt upon an award where the submission is not by specialty, or for a copyhold fine, or for an escape, or money levied upon any writ of *fieri facias*, within six years; and all actions for penalties, damages, or sums of money, given to the party aggrieved, by any statute, within two years after the cause of such actions or suits. Provision is made, as in the other cases, for persons labouring under disabilities; and also, in the case of any acknowledgment in writing signed by the party liable, or his agent, or any payment made on account of any arrears of principal or interest, the limitation reckons from the last of such payments or acknowledgments. Limitations as to tithes and other ecclesiastical property are now regulated by 2 & 3 Will. IV. c. 100, and 3 & 4 Will. IV. c. 27. (*See* also PRESCRIPTION.) Limitation of estate is a modification or settlement of an estate, determining how long it shall continue.—*Ref.* Stephen's *Commentaries on the Laws of England.*

LIMITED LIABILITY. (*See* PARTNERSHIP.)

LIMNANTHACEÆ, *lim-nǎn-thay'-se-e* (Gr. *limne*, a marsh; *anthos*, a flower), in Bot., a small nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, included by Lindley in the *Tropæolaceæ*, with which it agrees in general characters. It is, however, distinguished from that order by having regular flowers, more evidently perigynous stamens, and erect ovules. There are but two genera and three species, natives of North America.

LINACEÆ, *lin-ai'-se-e* (Lat. *linum*, linen), in Bot., the Flax fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, having the following essential characters:—Herbs, or very rarely shrubs, with exstipulate, simple, entire leaves. Flowers hypogynous, regular, and symmetrical; sepals, petals, and stamens 3—4—5 each; the sepals persistent and imbricate; the petals deciduous and twisted in æstivation; the stamens united at their base, and having little tooth-like abortive stamens alternating with them; ovary 3—4—5-celled, styles distinct; stigmas capitate. Fruit capsular, many-celled, each cell more or less divided by a spurious dissepiment, and each division containing one seed. Seeds with little or no albumen, and having a straight embryo. The *Linaceæ* are chiefly natives of the south of Europe and north of Africa. There are four genera and 90 species. They are generally remarkable for the tenacity of their liber fibres, and also for the mucilage and oil contained in their seeds. (*See* LINUM.)

LINDEN-TREE. (*See* TILIA.)

LINE, *line* (from Lat. *linea*, a line), in Geneal., is a series or succession of relations from a common progenitor.—In Naut., a *ship of the line* is a vessel with three tiers of guns. (*See* NAVY.)—In Mil., *troops of the line* are regular foot regiments.—In Geog., *the line* is an imaginary line drawn round the earth to represent the equator; and "crossing the line" is passing this fictitious boundary; on which occasion formerly great ceremonies used to be performed, which are now, however, abandoned.

LINE, in Math. (*See* GEOMETRY.)

LINE OF BATTLE, a general name given to the arrangement or order in which a fleet of ships of war are disposed to engage an enemy. This disposition, which is best calculated for the operations of naval warfare, is formed by drawing up the ships in a long file, or right line, prolonged from the keel of the hindmost to that of the foremost, and passing longitudinally through the keels of all the others, from the van to the rear; so that they are, in nautical parlance, in the *wake* of each other. In the line of battle, all the ships of which it is composed sail one point free when upon a wind on the starboard or port tack, and about one hundred fathoms distant from one another. A fleet is more particularly drawn up in line when in the presence of the enemy; and the ships are so arranged as to be able to fire upon the enemy without incommoding the ships of their own squadron. All the ships composing the line have not less than two decks; hence they are called *line-of-battle* ships.

LINEAL. (*See* CONSANGUINITY, KIN OR KINDRED, DESCENT.)

LINEAR PERSPECTIVE. (*See* PERSPECTIVE.)

LINEN, LINEN MANUFACTURE, *lin'-en* (Lat. *linum*, flax).—Linen is a general name for a cloth of very extensive use, made of flax, and differing from cloths made of hemp only in its fineness. The manufacture of linen is of so ancient a date that its origin is unknown. At a very early period linen cloths were made in Egypt, the cloth wrappings of the mummies being all composed of this substance. In the time of Herodotus linen was exported from Egypt; it also formed the dress of the Egyptian priests, who wore it at all their religious ceremonies; hence they were called "linen-wearing" by Ovid and Juvenal. Linen passed from Egypt to the Romans, but not until the time of the emperors, when the Roman priests began to wear linen garments. Linen was also used as a material for writing: the Sibylline books, and the mummy bandages covered with hieroglyphics, are instances of this use of the fabric. Linen and woollen cloths formed the only material for dresses during the middle ages; and fine linen was held in very high estimation, the manufacture being carried to the greatest perfection in Germany and Brabant. Cotton, on account of its cheapness, has taken the place of linen for many purposes; but good paper cannot be manufactured without linen. In Britain, linen has been manufactured for a very long period. During the reign of William III. the woollen manufacture in Ireland was suppressed, because it was alleged that it interfered prejudicially with the clothiers of England. To this circumstance the growth of the Irish linen manufacture is ascribed; for at the same time the linen-weavers were encouraged by premiums given by public boards authorized by act of parliament. As early as the 11th century linen was woven in Ireland, and Louis Crommelin, about 1696, driven from France by the revocation of the edict of Nantes, established the manufacture on a new basis. In 1725 machinery was first used in the manufacture of linen; and, shortly afterwards, the processes were greatly improved by a new method of bleaching invented by Dr. Ferguson, of Belfast. Flax was first spun by machinery by Messrs. Mulholland, of the same town, in 1820. The Linen Board was dissolved in 1828, and in 1841 a society was established for the encouragement of the growth of flax in Ireland. It is difficult to ascertain the exact quantity of linen exported from Ireland, but the average quantity, about 1790, was above 31,000,000 yards. In 1857, the exports from all Ireland were supposed to amount to about 106,000,000 yards, valued at £4,400,000. Early in the last century the

linen manufacture was introduced into Scotland, and in 1727 a board of trustees was established for the superintendence and improvement of the linen manufacture. Notwithstanding the institution of this board, and the bestowal of premiums on the production and exportation of linen, the manufacture did not progress in the same way as that of cotton and other similar fabrics. In 1745 only 74 tons of flax were imported into Dundee, the grand seat of the Scotch linen manufacture. In 1791 the imports of flax amounted to 2,444 tons, and in 1858 the average imports of flax and hemp had increased to 46,360 tons. The quantity of linen cloth exported from Dundee in 1850 amounted to about 1,000,000 pieces, containing about 120,000,000 yards. In the process of manufacture, the flax fibres are first steeped and freed from woody particles. (*See* FLAX.) Very little machinery was used in the manufacture of linen cloth till recently. After being freed from the woody particles, the distaff and spinning-wheel were used in order to make the thread or yarn, and the hand-loom was employed for the purpose of weaving the cloth. About the middle of the 18th century, the inventions of Hargreaves and Arkwright were first applied to the manufacture of linen, at Leeds. (*See* COTTON MANUFACTURE.) When brought to the spinning-mills, the flax is in small bundles, weighing a few pounds each. The first process is called *scutching*, by which the fibres are subjected to a sort of combing action, in a machine. They are next *heckled*, an operation by which they are cleaned, the coarser parts being removed, and the rest arranged in a parallel direction to each other. This used to be done with the *heckle*, a sort of large comb with iron teeth; but the operation is now effected by a rotating machine, on the outer circumference of which the flax is fixed, and drawn against or between a series of sharp teeth. The fibres pass through six heckling machines in succession, each of which has finer teeth than the one preceding it. After being heckled, the flax is divided into portions, selected according to their fineness, &c. The next process is that of *drawing*, similar to the carding process in the cotton manufacture. (*See* CARDING MACHINE.) In this operation the flax is doubled and carded repeatedly, till it presents the appearance of a smooth glossy band, about an inch in width, called a *sliver*. All the good portion of the flax at this point is called *line*, and all the irregular short fibres, *tow*. This tow is not the rough substance generally known by the name: the latter is the refuse of hemp. Flax tow can be drawn, doubled, carded, and spun into yarn of coarse quality. The principal object in drawing the heckled fibres is to form a sliver of uniform thickness, or such that a foot in length taken at any one place will be equal to a foot in length taken at any other place, or as nearly so as possible. The drawn sliver is next taken to the *roving*-frame. The use of this machine is to give the sliver another drawing, also a slight twist, and to wind it upon a bobbin. These processes are all preparatory for the spinning of the yarn. This is effected on the bobbin-and-fly principle, and the flax spinning-frame acts similarly to the *throstle* used in cotton-spinning. Flax, however, differs from cotton, wool, and silk, as it requires to be wet while under the process. Formerly it was wetted with cold water, but it is now found that finer yarn can be produced when warm water is used. In general, the rove or twisted sliver, before it passes through the retaining rollers, is led through a trough of water kept hot by steam. The spun yarn is applicable either for making thread, or for weaving into linen cloth. The quality of flax is denoted by numbers expressing the number of *leas* in a pound weight; a lea being a measure of 300 yards. Thus, No. 50 has 50 leas, or 15,000 yards. Flax is seldom spun finer than No. 200, which contains 60,000 yards. No. 200 is applicable for making cambric of fine quality. Leeds is the great centre for flax-spinning; but weaving is carried on in other places. Linen, duck, cheque, tick, huckaback, diaper, drill, towelling, and other flax fabrics, are woven at and about Barnsley; while sail-cloth, dowlas, sheeting, and other strong textile fabrics, are manufactured at Dundee and also at Aberdeen. Shirtings, damasks, tablecloths, and other fine fabrics, are produced at Dunfermline; while Belfast is famous for good linen and the finer kinds of textile goods. Amongst these are duck made in widths from three to five quarters of a yard; drill, or twilled linen, white or coloured, mostly used for summer trousers. Damask, diaper, and cambric, are noticed under their respective headings. Many of the fabrics called linen cloths are made either of flax or hemp, according to the prices at which they are to be sold. Sail-cloth is dressed with starch or flour before weaving; and most kinds of flaxen and hempen fabrics require some similar dressing. The manufacture of linen is not carried on in this country only, but extensively on the continent, in Bohemia, Moravia, Silesia, and Galicia. Within the Austrian dominions the most important linen fabrics manufactured are table-cloths, napkins, veils, cambrics, dimities, twills, and drills. The manufacture of thread in Bohemia, Moravia, and Lombardy, is also of considerable importance. The linen trade is divided into three parts, which relate respectively to the seed, the fibre, and the woven goods. The annual importation of linseed is 4,000,000 bushels, four-fifths of which are used for making linseed-oil, and one-fifth for sowing into a flax crop. The principal supply comes from Russia, the sowing-seed being carefully prepared, and imported in casks officially branded. The crushing-seed, for making oil, is coarser, and is packed in malt-bags or sent in bulk. The computed value of the seed and fibre imported in 1858 was £2,700,000. The import of woven flaxen goods is very small in this country. The North American States, Brazil, Cuba, and the Hanse Towns, but especially the first, are by far the largest importers of manufactured linens. According to McCulloch, the entire value of the linen manufacture of Great Britain and Ireland is estimated at about £12,000,000. The duty on imported linen, which was raised in France in 1842, was abolished by the commercial treaty signed with France, Jan. 23rd, 1860.

LINES, *lines*, in Mus., those members of the stave between and upon which the notes are placed. The stave itself consists of five lines only, but other and smaller lines, called *ledger-lines*, are placed above and beneath, for the reception of all notes that are too high or too low to come within the stave. The invention of lines is attributed to Guido. At their first introduction the spaces between them were not used.

LINES OF INTRENCHMENT.—When an army is encamped for a brief space of time in the open field, or engaged in offensive operations against a beleaguered town, it is not considered necessary to construct a continuous series of works, which are termed lines of intrenchment, for its defence; but a few redoubts and breastworks, thrown up here and there, are deemed sufficient for the protection of any weak part of the position that may be easily approached and assailed by the enemy's forces. Circumstances, however, may occur, under which an army is compelled to remain entirely on the defensive, when continuous lines of intrenchment, or a series of redoubts skilfully disposed, must, of necessity, be thrown up for its protection. All fieldworks of this kind consist of a parapet of earth about seven or eight feet high, with a banquette behind it and a ditch in front of it; the earth which is taken out of the ditch being used in making the parapet. This part of the work should be three or four feet thick at least, if required for a protection against musketry only; but if it is intended to withstand a fire from field-pieces, it should be twelve feet in thickness. The inner and outer slopes of the parapet should be revetted with turf, and a row of palisades or sharpened stakes should be fixed at the foot of the counterscarp. The outline of the work depends entirely on the nature of the ground along which the intrenchments are to be thrown up. The best form for a continuous breastwork of great length in an open country is that of a series of redans, each formed by two faces, about 150 feet in length, meeting in a salient angle of 60°, the extremities of the adjacent faces of each pair of redans being connected by a curtain extending about thrice their length on two faces, which meet in a point a little in advance of the straight line along which the curtain would otherwise be constructed, forming an angle of 135° or 140°. When the lines of intrenchment run along the side of a river or road, and it is consequently impossible to construct them after the manner just described, from want of room to throw out the salient angles of

the redans so many feet in advance of the curtains that connect them, a breastwork, resembling a set of steps in form, and consisting of a long face and a short face successively, inclined to each other in salient and re-entering angles of 100°, may be thrown up. Care must be taken to dispose the lines of direction of the faces of the works in either case in such a manner that it may be difficult for the enemy to obtain positions from which they could enfilade them with artillery. In the form of intrenchment first described, the entrances should be in the centre of the curtains, and in the zig-zag lines of breastwork they should be formed in the re-entering angles. Detached works, constructed on any elevations that can be secured about the position occupied by an army, are considered better for its defence, provided that they are not at too great a distance from each other, than a continuous line of parapet; as the troops are able to issue readily from them to form an extensive front for offensive operations against the enemy, and to retreat with equal facility and safety, if compelled to do so; while it is a matter of great difficulty to do either when the only means of ingress and egress are afforded by the narrow entrances in the curtains connecting the redans or the re-entering angles of the zigzag line of parapet, on which the fire of the enemy would be immediately concentrated. In addition to this, if the enemy penetrate a continuous line of intrenchments at any point, the whole line is at once turned; but they cannot advance between detached redoubts without being exposed to a galling and destructive cross-fire from them.

LING, *ling* (Du. *leng*), (*Lota molva*), a well-known and valuable fish, belonging to the family of the *Gadidæ* (Codfish family). In addition to the generic characters of the *Gadidæ*, which will be found given under article HAKE, it possesses the following especial one, namely, that it has a chin with one or two barbules upon it. The body of the ling is a little more elongated than the hake, being usually from three to four feet long. The back and sides are of a grey colour, somewhat inclining to olive, although occasionally cinereous; the under portion of the body silvery; ventrals white, dorsal and anal fins edged with white; and, lastly, the caudal, marked near the end with a transverse black bar, the extreme tip, like the other fins, being white. The ling is naturally an inhabitant of the northern seas, like the rest of its family. Great quantities of them are taken round the Western Islands, in the Orkneys, and on the Yorkshire and Cornish coasts. The mode of fishing for ling is by means of hand-lines and long lines; and besides a portion that is consumed fresh, the fish are split from head to tail, cleaned, salted in brine, washed, and dried. The demand, however, often falls short of the quantity cured, and thus the fishermen are poorly requited for their toil and outlay. The ports of Spain are the markets generally supplied: and so important an article of commerce was it considered, that an act for regulating the price of ling, cod, hake, &c., was passed. The air-bladders of the ling are, like those of the cod, prepared separately, and are sold under the name of sounds. When in season, the liver abounds with a fine oil. In 1854 it was calculated that the take in Scotland of cod and ling amounted to 3,523,269 fish, of which 1,385,609 were from the Shetland Islands. Of these, 109,684 cwt. were cured and dried, and 6,166 barrels were cured in pickle; whilst 58,043 cwt. were disposed of fresh; making a total of 167,726 cwt., cured or fresh; of which large quantity 19,577 cwt. were exported. Mr. Yarrell observes of it, "In Zetland, the principal fishing for ling is from May to August. On the Yorkshire coast, the young are called drizzles. In Cornwall, they are caught in January and February, and their favourite haunts are about the margins of the rocky valleys of the ocean. The ling is exceedingly prolific, and of most voracious appetite, feeding on young fish, not sparing anything that has life, and the prey is swallowed whole; so that no great art is required to catch it. It is tenacious of life, and survives great injury." (*See* FISHERIES and HAKE.)

LING, the name given by the Chinese to the plant termed *Trapa bicornis*, which produces edible seeds, said to be very delicious.

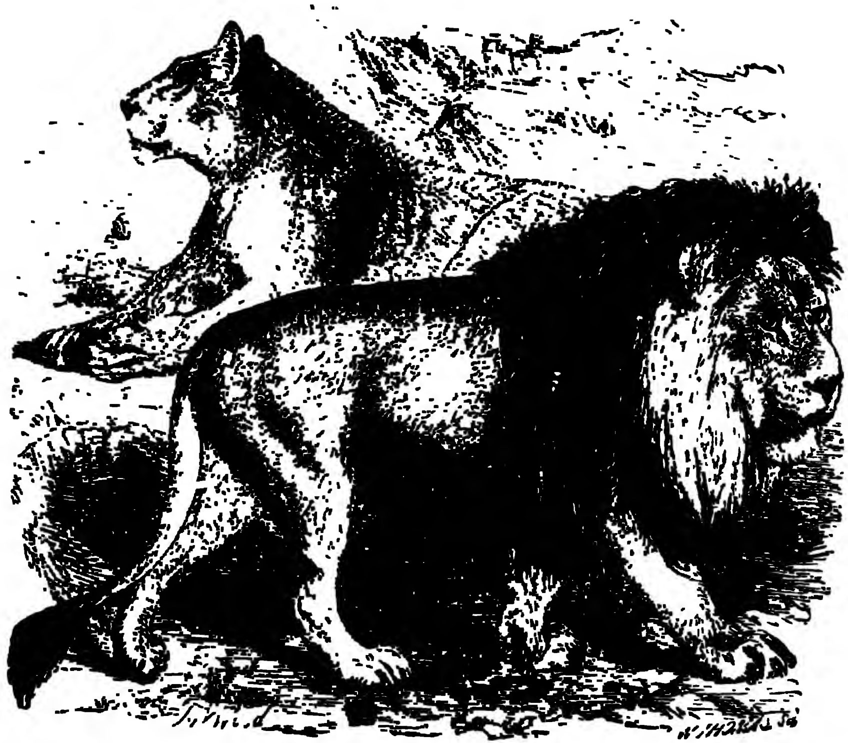
LINIMENT, *lin'-e-ment* (Lat. *lino*, I anoint), in Med., is an oily substance of a consistence intermediate between an ointment and oil, but so thin as to drop. The term is also applied to a spirituous or other stimulating application for external use.

LINNÆAN SYSTEM, *lin-ne'-an*, in Bot., the order of methodical arrangement of plants adopted by Linnæus, the Swedish naturalist, early in the 18th century. This system had the most surprising success, on account of its extreme simplicity, and the singular facility which it affords for attaining a knowledge of the names of plants. Up to that time each species was named by a characteristic phrase, in which the distinctive characters were frequently not included. These phrases were so long, that it was very difficult to retain any number of them in the mind. By the Linnæan system, a proper or generic name was given to each group or genus; and each species of these genera was designated by a specific name added to the generic. By this ingenious contrivance, the study of botany, then very extensive, was quickly simplified. (*See* BOTANY, and LINNÆUS, in vol. I. of this work.)

LINNET, *lin'-net* (Fr. *linot*, Sax. *linetwege*), a bird belonging to the fam. *Fringillidæ*, ord. *Incessores*, division *Conirostres*. Its characteristics have been described under the article FRINGILLIDÆ, and therefore they need not be here alluded to. The common linnet (*Linota cannabina*) is well known in England, where it is sometimes also called the brown linnet, or rose linnet. The male of this bird, in summer, has the beak of a bluish lead-colour, the irides hazel; the feathers on the fore part and top of the head greyish brown at the base, but vermilion-red at the top; round the eye, the ear-coverts, and back of the neck, greyish brown; the whole of the back, wings, and upper tail-coverts, uniformly of a rich chestnut-brown; the quill-

feathers are nearly black, with narrow outer margins of white; tail-feathers black, with narrow outer edges, and broad inner ones of white; the chin and throat are coloured with a mixture of brown and grey; the breast is vermilion-red, with a few pale brown feathers intermixed; the flanks and remainder of the bird are in general brown, including the legs, toes, and claws. In winter and autumn the linnet has no red colour on the head or breast, and the plumage is altogether of a more dusky hue than in summer. The female bird is a little smaller than the male, and the colour of its plumage is much lighter also. The *Mountain Linnet* is distinguished from the common linnet by the greater length of its tail, which gives the bird a more elongated and slender appearance. It is also still further distinguished by the colour of the feathers on its head, which are of a tawny reddish colour, in lieu of the vermilion-red of the common type. This bird is a winter visitor to the southern parts of England; but it often breeds both in the north of England and Scotland. Mr. Macgillivray observes of it, in a quotation extracted from Mr. Yarrell's "British Birds," that the mountain linnet "is plentiful in the Hebrides, and in winter frequents the corn-yards in large flocks, clinging to the stacks of oats and picking out their seeds. Its flight is rapid and undulated, and it flies in circles over the fields previous to alighting, uttering a soft twitter at intervals. In spring it forsakes its winter haunts, and disperses over the hilly tracts, where it forms its nest

Plate LXXXII.—AFRICAN LION AND LIONESS.



on the ground, amongst short heath, or on the grassy slopes of craggy spots. The nest is neatly constructed, being composed externally of fine dry grass, fragments of heath, and a little moss; internally of fibrous roots, wool, and hair. The eggs are bluish-white, marked towards the larger end with light brown and purplish red, sometimes with a few blackish dots." (*See also* article FRINGILLIDÆ.)

LINSEED. (*See* LINUM.)

LINSEY-WOOLSEY, *lin'-ze wool'-ze* (Ang.-Sax, from linen and wool), a coarse kind of flannel cloth, the woof of which only is made of wool, the warp being made of thread. It is usually employed to make clothing for those who are entirely dependent upon public charity.

LINT, *lint* (Sax. *linet*, from *linum*, flax), a term applied to old white linen cloth, scraped by hand or machinery, so as to render it soft and woolly. It is used for dressing wounds, ulcers, &c., either alone, or smeared with some suitable ointment or cerate.

LINTEL, *lin'-tel* (Fr. *linteau*), in Arch., the head of a doorway or window, which is generally formed by a cambered arch of brick or masonry, or a stout beam of timber resting horizontally on the vertical jambs or sides of the aperture, to support the weight of that part of the wall which is built immediately above it.

LINUM, *li'-num* (Lat.), in Bot., the most important genus of the nat. ord. *Linaceæ*. The liber-fibres of *L. usitatissimum*, when prepared in a certain way, constitute *flax*, of which linen fabrics are made. Linen, when scraped, forms *lint*, which is so much used for surgical dressings. The short fibres of flax which are separated in the course of its preparation constitute *tow*. The seeds of the flax-plant are called *linseed*. The seed-coat contains much mucilage, and the nucleus of the seed oil. The oil may be readily obtained from the seeds by expression; the amount depends on the method adopted, and varies from 18 to 27 per cent. *Linseed-oil* is especially remarkable for drying rapidly when applied to the surface of any body exposed to the air, and thus forming a hard transparent varnish. This property of drying quickly is much developed by previously boiling the oil, either alone or with some preparation of lead. The cake left after the expression of the oil is known as *oil-cake*, and is much used as food for cattle. When powdered, it is commonly sold as *linseed-meal*, which is much used for making poultices and for other purposes. The linseed meal, however, as directed to be used in the London Pharmacopœia, is merely linseed powdered; hence it contains the oil, which is not present in ordinary meal.

LION, *li'-on* (Fr., from Lat. *leo, leonis*) —This animal, erroneously described by the ancients as the king of beasts, belongs to the family of the *Felidæ*, a genus of the class *Mammalia*, order *Færa* (rapacious beast), of which family the lion is the type. The dental formula of the lion may be thus scientifically expressed:—

$$\text{Incisors } \frac{6}{6}, \text{ canines } \frac{1-1}{1-1}, \text{ molars } \frac{4-4}{3-3}; \text{ total } 30.$$

When called into action, these teeth act like the antagonistic blades of a pair of scissors upon the substance submitted to their cutting edges. The canine teeth are very long and large. The feet of the lion, like the rest of the cat family, exhibit one of the most beautiful conformations of nature. In walking, only the soft parts touch the ground; and hence their tread is noiseless. The lion thus glides along with a stealthy pace until it crouches within proper distance, when it springs with fearful velocity and force upon its unsuspecting prey. Another adjunct of terror with regard to this animal is the fearful roar which it emits at the moment it pounces on its prey: its unhappy victim being deadened, as it were, with fright at the same moment as it feels its enemy's talons and murderous teeth. The other generic characteristics of the animal will be found given under the article FELIDÆ. Formerly only one species of the lion was admitted by zoologists; but of late, as discovery has opened fresh fields for investigation, it would appear that there are several degrees and varieties of this animal. At one time they must have been, from the frequent allusions made to them in Scripture, tolerably abundant in Syria, Palestine, and Egypt; but at the present day they have totally disappeared from those countries. Of all the different varieties which have been observed by naturalists, the African lion (*Leo africanus*) is by far the finest, most powerful, and the most ferocious. Of this there are three different specimens, which may be thus enumerated,—the Barbary lion, from Barbary and North Africa; the Senegal lion, from Senegal and the west of Africa; and, lastly, the Cape lion, from South Africa and the Cape of Good Hope. The general prey of the African lion consists of the larger herbivorous quadrupeds; and there are few of these which it is unable to master. When aroused, lions retreat slowly; and if no cover is near, when they have got to a sufficient distance, they bound away at a prodigious rate. They seldom, if ever, invite conflict with man, always trying to retreat; but when they are shot at, and are wounded, they then turn on their pursuer with fearful ferocity. The following recital, which is taken from a work entitled "Zoological Anecdotes," refers to Mr. Cuming's work on hunting in South Africa, and furnishes a tolerably characteristic sketch of the habits of the lion:—"Mr. Cuming had shot three rhinoceroses near a fountain, and soon after twilight had died away, he came down to the water to watch for lions. With him was his Hottentot, Klinboy. 'On reaching the water, I looked towards the carcass of the rhinoceros, and, to my astonishment, I beheld the ground alive with large creatures, as though a troop of zebras were approaching the water to drink. Klinboy remarked to me that a troop of zebras were standing on the height. I answered, 'Yes;' but I knew very well that zebras would not be capering around the carcass of a rhinoceros. I quickly arranged my blankets, pillow, and guns in the hole, and then lay down to feast my eyes on the interesting sight before me. It was bright moonlight, as clear as I need wish. There were six large lions, about twelve or fifteen hyænas, and from twenty to thirty jackals, feasting on and around the carcasses of the three rhinoceroses. The lions feasted peaceably, but the hyænas and jackals fought over every mouthful, and chased one another round and round the carcasses, growling, laughing, screeching, chattering, and howling, without any intermission. The hyænas did not seem afraid of the lions, although they always gave way before them; for I observed that they followed them in the most disrespectful manner, and stood laughing, one or two on either side, when any lions came after their comrades to examine pieces of skin and bone which they were dragging away." The following account of an attack by one of these man-eaters, as they are termed (for, having once tasted human flesh, they will eat nothing else if it can be obtained), makes the blood run cold. Mr. Cuming and his party had, unknown to them, pitched their camp in the proximity of a lion of this description. All had retired to rest, when (says Mr. Cuming) "suddenly the appalling and murderous voice of an angry and bloodthirsty lion burst upon my ears within a few yards of us, followed by shrieking of the Hottentots. Again and again the murderous roar of attack was repeated. We heard John and Ruyter shriek 'The lion, the lion!' still, for a few moments, we thought he was but chasing one of the dogs round the kraal; but the next instant John Stofulus rushed into the midst of us, almost speechless with fear and terror, his eyes bursting from their sockets, and shrieked out, 'The lion! the lion! He has got Hendrick! He dragged him away from the fire beside me! I struck him with the burning brands upon his head; but he wouldn't let go his hold. Hendrick is dead! O God! Hendrick is dead! Let us take fire and seek him.' The rest of my people rushed about shrieking and yelling as if they were mad. I was at once angry with them for their folly, and told them that if they did not stand still and keep quiet, the lion would have another of us, and that very likely there was a troop of them. I ordered the dogs, which were nearly all fast, to be made loose, and the fire to be increased as far as could be. I then shouted Hendrick's name; but all was still. I told my men that Hendrick was dead, and that a regiment of soldiers could not now help him; and hunting my dogs forward, I had everything brought within my cattle kraal, when we lighted our fires and closed the entrance as well as we could. It appeared that when the unfortunate Hendrick rose to drive in the ox, the lion had watched him to his fireside, and he had scarcely

lain down when the brute sprang upon him and Ruyter (for both lay under one blanket) with his appalling murderous roar, and roaring as he lay, grappled him with his fearful claws, and kept biting him on the breast and shoulder, all the while feeling for his neck; having got hold of which, he at once dragged him away backwards round the bush into the dense shade. As the lion lay on the unfortunate man, he faintly cried, 'Help me! help me! O God! men, help me!' After which the fearful beast got hold of his neck, and then all was still, except that his comrades heard the bones of his neck cracking between the teeth of the lion." Many more anecdotes of a similar nature will be found in Mr. Greenwood's interesting work, "Wild Sports of the World." The colour of the African lion is generally a tawny yellow, like the general class *Leo;* the only exception being the Cape lion, which is of a more brownish colour. Of Asiatic lions there are three varieties,—the Bengal, the Persian, and the maneless lion of Guzerat. The first of these is smaller in size, with a less expansive mane, and it is usually of a lighter colour than the African. It also does not possess the same degree of courage which distinguishes the latter. The Persian lion is characterized by the pale yellow colour of its fur. The maneless lion of Guzerat (*Leo goojratensis*) is distinguished from the other species of lions by its being nearly destitute of th[illegible] the mane, which is such a striking fea[illegible] of the African and Bengal lions. This variety is found in Guzerat, along the banks of the river Sombermuttee, near Ahmedabad, extending through a large tract of country about forty miles in length. A very excellent sketch of this animal, which we are unable to insert, will be found in the "Transactions of the Zoological Society" for the year 1833. The lion has been hailed by the title of "king of beasts," and "monarch of the forests," and has been considered as the emblem of majesty and might. It is the symbol of the British nation, and is borne on the royal arms. But all the poetic imagery with which it has been surrounded i[s] altogether unlike its real nature, which is characterized by its overwhelming its prey merely by surpris[e] in attack, and its running away, generally, at th[e] slightest display of resistance from man,—sometimes even the sight of man is sufficient to cause the "king of beasts" to take to degrading flight. (*See*, also, articles FELIDÆ and MAMMALIA.)—*Ref.* Baird's *Encyclopædia of the Natural Sciences;* Owen's *Natural History*.

LION and UNICORN.—These heraldic supporters of the royal arms of England were first adopted on the accession of James I., A.D. 1603. The lion was previously the supporter of the English, and the unicorn the supporter of the Scottish shi[e]ld.

LIP, *lip* (Sax. *lippa*, Lat. *labium*), in Anat., constitutes the outer edge or border of the mouth. The lips are formed by muscular fibres, glands, and cellular tissue, covered by mucous membrane. They owe their extremely red colour to the thinness of the covering membrane, and their sensitiveness to an abundant supply of minute nervous fibres. They are not unfrequently affected with cancer. (*See* CANCER.) The lips form part of the organs of speech, and are necessary to the pronunciation of certain letters, which are hence called labials or lip letters.

LIPIC ACID, *li'-pik*, in Chem., one of four fixed fatty acids remaining in the retort when oleic acid is distilled with nitric acid.

LIPOGRAMMATIC, *lip-o-grăm-mat'-ik* (Gr. *leipo*, I omit, and *gramma*, a letter), in Lit., is a term applied to certain compositions in which particular letters are invariably left out. Thus, Tryphiodorus is reported by Hesychius to have written an Odyssey in which there was no *a* in the first book, no *b* in the second, and so on. [illegible]ga wrote a novel without using the letters [illegible] G. W. Burmann wrote a po[e]m in German without the letter *r*. The production of such works is laborious trifling; it serves no purpose, and the selection of particular words must seriously interfere with the natural course of the poem or narrative.

LIPOMA, *li-po'-mă* (Gr. *lipos*, fat), in Surg., is a soft indolent tumour, arising from a luxuriancy of fat in the cellular membrane.

LIPPITUDO, *lip-pe-tu'-do* (Lat. *lippus*, blear-eyed), is a chronic inflammatory disease of the eyes, commonly called bleared-eyes. It consists in the exudation of a puriform humour from the margins of the eyelids, which often causes them to stick together during the night. (*See* OPHTHALMIA.)

LIPYL, OXIDE OF, *lip'-ile*, in Chem., C_3H_2O, a hypothetical body, supposed by Berzelius to form the base of oils and fats, and to unite with two equivalents of water to form glycerine at the moment of decomposition.

LIQUEFACTION, *lik-we-făk'-shun* (Lat. *liquefactio*), the act or operation of melting or dissolving, or the conversion of a solid into a liquid by the agency of heat. When heat is applied in sufficient quantity to any solid body, it changes its form and becomes liquid. In the case of ice, this change is called liquefaction; but in the case of the metals it is more frequently called fusion. Under the combined influence of pressure and cold, nearly all the gases have been liquefied. Bodies require very various degrees of temperature for liquefaction. Mercury, for example, fuses at 39° below zero; while wrought iron requires a temperature as high as 3280°. (*See* FUSING-POINTS.)

LIQUEUR, *lik'-yure* (Fr.), a palatable spirituous cordial composed of water, alcohol, sugar, and some aromatic infusion extracted from fruits, seeds, &c. Different liqueurs vary according to the proportions of sugar and alcohol contained in them. Amongst the French they are divided into three classes. First, the *ratafias*, or simple liqueurs, in which the sugar, the alcohol, and the aromatic substance are in small quantities. Amongst these are anise-water, noyau, and the apricot, cherry, and other ratafias. The second division consists of the oils, or fine liqueurs, with more saccharine and spirituous matter; as the anisette, curaçoa, &c. The third are the creams, or superfine liqueurs, such as rosoglio, maraschino, Dantzic water, &c. In some cases, the same aromatic infusion may give its name to two different liqueurs, according to the proportion of their constituent materials, as *eau de noyau* and *crème de noyau*.

LIQUID, *lik'-wid* (Lat. *liquo*, I melt), a fluid; a material substance the particles of which have a perfect freedom of motion, without any sensible tendency to approach to or recede from one another, except by the action of some external power. Liquidity, as a condition of matter, is therefore comprehended in the condition of fluidity. (*See* FLUID.) The particles of a liquid are held together with considerable force, notwithstanding their freedom of motion; since a small quantity of a liquid has a tendency to take a spherical form when at a distance from any substance for which its particles have greater affinity than for one another This is particularly apparent in mercury, oil, and water. The first of these, upon being allowed to drop on a table, separates itself into globules; and the two others take a similar form when a small quantity of either is suspended from the extremity of a pointed object The form of the dewdrop is also another familiar instance.

LIQUIDAMBAR, *lik'-wid-ăm-bar*, in Bot., a gen. of balsamiferous trees, constituting the nat. ord. *Altingiaceæ*, or *Balsamifluæ*. There are three species, which are natives of the warmer parts of India, North America, and the Levant. *L. orientale* yields the *liquid storax* of the shops: this is obtained from the inner bark, which is afterwards used by the Turks for the purpose of fumigation, and is the *cortex thymiamatis* or *storax bark* of pharmacologists. In Cyprus the tree is called *xylon effendi* (the wood of our Lord). *L. styraciflua*, an American tree, yields by incision a fluid balsamic juice, called *liquidambar*, or *copalm balsam*. *L. altingia*, a native of Java, yields a similar fragrant balsam. In their effects and uses, these products resemble the balsams of Peru and Tolu, benzoin, &c.

LIQUIDS, *lik'-widz* (Lat. *liqueo*, I flow), in Gram., is a term applied to the four letters *l*, *m*, *n*, *r*, from their readily uniting with other consonants, and flowing, as it were, into their sounds. They are also called semivowels.

LIQUORICE. (*See* GLYCYRRHIZA.)

LIST, *list* (Ang.-Sax.), is used to signify the inclosed field or piece of ground wherein the ancient knights held the jousts and tournaments. It was so called from being surrounded with pales, barriers, or stakes, as with a list or border, like a piece of cloth. Some of

these were double, one for each cavalier, separatin them from each other, so that they could not approac within a spear's length. Hence, to enter the lists used figuratively to denote engaging in a contest.

List, Civil. (*See* Civil List.)

Lit de Justice. (*See* Bed of Justice.)

Litany, *lit'-ă-ne* (Gr *litaneia*, supplication), signifie a general supplication for the removal of any calamit by which a church, community, people, or nation, ma be afflicted. As to the form in which litanies ar made,—namely, in short petitions by the priest, witl responses by the people, St. Chrysostom derives th custom from the primitive ages, when the priest begar and uttered by the spirit some things fit to be prayec for, and the people joined in the intercessions, saying, "We beseech thee to hear us, good Lord." Several of these forms were afterwards written down, anc were the original of our present litanies. Abou A.D. 400, litanies began to be used in processions, th people walking barefoot, and repeating them witl great devotion. At first the use of litanies was no fixed to any stated time; they were employed only as exigencies required. The council of Orleans, A.D. 511, expressly recognizes litanies as peculiarly solemn supplications, and enjoins their use preparatory to the celebration of a high festival. In the Spanish church, in like manner, they were observed in the week afte Pentecost. Other countries subsequently appointec them at a variety of other seasons, till, in the seventeenth council of Toledo, A.D. 694, it was decreed that they should be used once in each month. By degrees they were extended to two days in the week; and Wednesday and Friday, being the ancient stationary days, were set apart for that purpose. These days are appointed by the fifteenth canon of our church for using the litany, to which, by the rubric, Sunday is added, s being the day of the greatest assembly for divine service. About A.D. 600, Gregory the Great, from all the litanies extant, composed the famous Seven-fold litany (*Litania septiformis*), by which Rome is said to have been delivered from a grievous pestilence. This has been the model followed by all the Western churches since that time, and ours comes nearer to it than that in the present Roman missal, wherein later popes had put invocations of saints and such-like, which our reformers justly expunged. The Church of England litany, however, is not an exact transcript of any ancient form, though composed of materials of very ancient date. Before the last review of the common prayer, the litany formed a distinct service by itself, not used at the time of the other services; but it has since been united with the morning prayer, though still retaining its separate place in the Prayer-book. The litany is usually considered as embracing four main divisions; viz., invocations, deprecations, intercessions, and supplications.

Litchi. (*See* Nephelium.)

Literary Property. (*See* Copyright.)

Literati, *lit-e-ra'-te* (Lat. *litera*, a letter), denotes, in general, learned men, or men of letters. In China, it is applied to all such as are able to read and write their own language; and is also the name of a particular sect, composed principally of the most learned men of that country, and called the *jukias*, or learned. The literati alone are capable of being made mandarins.

Literature, *lit'-e-ră-ture* (Lat. *litera*, a letter), in its widest signification, denotes the whole of what has been written. This is the meaning which the word usually bears on the continent; but with us it is generally restricted to what may be termed elegant literature, or *belles-lettres*, to the exclusion of works of positive science and mere erudition. Taken in its widest signification, it is usual to divide it into several distinct parts, according to periods or countries, or its different kinds. Thus we have the literature of the ancient world, of the middle ages, and of modern times; the literature of Greece, Rome, &c.; prose literature, poetical literature; and so on. Under the names of the different countries will be found an account of their literature. The history of literature is a subject of vast extent and importance, and demanding for its execution a union of some of the highest faculties. It demands an extensive and minute acquaintance with works on the greatest variety of subjects; a power of critically discerning their various merits; a knowledge of their different authors; and a power of tracing the dependence or bearing of one work upon another. To literature, "in the most especial manner, belongs poetry, and, next in degree, narrative and descriptive history; then reasoning and pure speculation, in so far as they influence the actions of human life; finally, wit and eloquence, provided they do not evaporate in the fleeting breath of words, but display themselves in the enduring form of written productions."—(*Schlegel.*) The main object of literary history is to show the general progress and phases of intellectual development, and of æsthetic and moral culture. Political history deals chiefly with events, literary history with thought; each merges into the other, and they are necessarily connected in any complete narrative. If we contemplate the tree of collective knowledge and art, with its branches ramifying through all ages and tongues, through all gradations of mental culture, we find that it may be traced more particularly to ten nations. Our eye is first captivated by the flowery fields of Greek literature and art, the conspicuous beginning of all mental culture. On examining it more closely, we are carried back into oriental regions, where the stupendous monuments of Hindostan, the gigantic ruins of which stand forth as the relics of a former world, meet our wondering gaze on the firmest rock of this primordial world. Moses laid the foundations of the temple of Hebrew prophecy, the glory of which irradiated the olden poetic and sacred tradition of Persia with a kindred refulgence as far as it can be discerned amid the impure admixtures of Arab creed. Both elements of mental culture, Greek and Oriental, after passing through the earnest Roman world, flow into Christian ages, in which a new living stem of noble intellect, grafted on the old northern stock, has shot forth with great vigour among the four most cultivated nations of the west,—the Italians, French, Spaniards, and English—in poetry and criticism, in arts of every kind, and in philosophy, both true and false. The German mind forms the connecting bond of this intellectual development of the four great Romanic nations; inasmuch as it has been the cause and mainstay of the great intellectual burst throughout Europe. "The spiritual culture of those four nations rests on what we have already more than once characterized as the four elementary powers of common objective perception; accordingly, we see in the Italians imagination and a love of art; in the French, reason and oratory; in the English, keen perception and historic powers; and in the Spaniards, intense nationality and poetical feeling. But the German mind explores the more profound hidden springs of the inner life, where those elementary forces no longer appear disunited, but the entire power of living consciousness, both in thought and art, proceeds from one common root."—(Schlegel's *History of Literature.*) From the difficulty of the undertaking, it is not to be wondered at that works on general literature are so rare. Even to take up the literature of a particular people, or time, or science, is a labour that few are equal to; but some excellent works on these departments exist, and those on the literature of the different countries are referred to in these articles. The classical and mediæval writers have rendered scarcely any service to this department, except by leaving materials. The classics contain only scattered and detached materials for a literary history, partly in biographies of poets, philosophers, orators, &c.; partly in criticisms and extracts from their writings. The nearest approach to a history of literature among the ancients occurs in a single chapter of Quintilian (B. x. c. i.), in which he passes rapidly over the names and characters of the poets, orators, and historians of Greece and Rome. Paterculus, also, in a remarkable passage, shows from historical instances how great men are found to cluster together at particular times and in particular places. The father of literary history is the celebrated Conrad Gesner, whose work "Bibliotheca Universalis" (1545-5) contains vast stores of knowledge on the subject of authors and their writings, arranged, however, not in chronological, but in alphabetical order. An Italian Jesuit, Possevin, made a somewhat nearer approach to a work of this kind in his "Bibliotheca Selecta," published at Rome in 1593. Still, notwithstanding

these works, Bacon might with justice deny that, up to his time, any real history of letters had been written; and he compares the world lacking this to a statue of Polyphemus deprived of his single eye. He gives the outlines of a scheme which should contain "the antiquities and originals of knowledges, and their sects, their inventions, their traditions, their divers administrations and managings, their flourishings, their oppositions, decays, depressions, oblivions, removes, with the causes and occasions of them, and all other events concerning learning throughout the ages of the world." Such a history, he says, would "make learned men wise in the use and administration of learning." No one has presumed to fill up the outline which Bacon himself could but sketch. The "Prodromus Historiæ Literariæ" of Peter Lambeck, which was published at Hamburg in 1659, was an attempt to frame a universal history of letters; but he was unable to carry it farther than the times of Moses and Cadmus. In 1688, Daniel Morhof, professor at Kiel, in Holstein, published his well-known "Polyhistor," a work of great erudition and judgment, and which in the next age received considerable additions at the hands of Fabricius. "In his review of books," says Hallam, "in every province of literature, Morhof adopts a sufficiently chronological order; his judgments are short, but usually judicious; his erudition so copious that later writers have freely borrowed from the 'Polyhistor,' and in many parts added little to its enumeration." But he was more conversant with writers in Latin than the modern languages; and in particular shows a scanty acquaintance with English literature. Another century elapsed before another great work of this kind appeared. The "Origine, Progressa, e Stato attuale d' ogni Letteratura" of Andrés, a Spanish Jesuit, was published at Parma (1782-99), in five vols. 4to. It is an extraordinary performance, embracing both ancient and modern literature in its full extent. His learning is very extensive, but not, generally speaking, profound, and his style is rather diffuse and indefinite; but his taste is correct, and his general views not injudicious. The work of J. G. Eichhorn,—"Geschichte der Literatur vom ihrem Anfange bis auf die neuesten Zeiten" (1805-11) (2nd edition, 12 vols., Gottingen, 1818), is more methodical and specific than any that had preceded it, but shows a less thorough acquaintance with science and the modern languages than with Oriental and theological literature. Of subsequent general literary histories the most important are Wachler's "Handbuch der Geschichte der Literatur" (3rd edition, 4 vols., 1833), and Grasse's "Handbuch der allgemeinen Literaturgeschichte" (1837-35). The first great work on the literary history of any particular country is that of Tiraboschi, of Italy. It appeared in 1772-92, in twelve volumes, 4to, and comes down to the close of the 17th century. "In full and clear exposition, in minute and exact investigation of facts, Tiraboschi has few superiors; and such is his good sense in criticism, that we must regret the sparing use he has made of it."—(*Hallam*.) A writer, inferior in reputation, but who devotes more attention to the analyzing of works than Tiraboschi, is Corniani, whose "Secoli della Letteratura Italiana dopo il suo Risorgimento" was published in nine volumes (1804-13). The French author Ginguéné has also written a history of Italian literature (1811-19). Sismondi's "History of the Literature of Southern Europe" is a pleasing and popular work, yet by no means superficial or unsatisfactory. There is no esteemed complete history either of French or English literature. The colossal literary history of France, undertaken by the Benedictines in 1733, is still unfinished. In 1857, Demogeot published a brilliant summary in one volume. Warton's "History of English Poetry," extending only to the reign of Elizabeth, has remained a favourite work. Hallam's "Introduction to the Literature of Europe in the 15th, 16th, and 17th Centuries" is a work hardly surpassed, in respect of learning and philosophical criticism, by any literary history. In Germany, Brucker, Tennemann, Buhle, and others, have written histories of philosophy. Vilmar is the principal general historian of German literature; Bouterwek, of modern poetry and eloquence (1801-19); Wilhelm von Schlegel, of dramatic literature (1809-11); and Ferdinand Wolf, of Spanish and Portuguese literature (1859). The most authoritative history of Spanish literature is that by George Ticknor, 3 vols. (1849). The love of literature is one of the most marked characteristics of an advanced civilization, and it exercises an important influence on practical life, on the destiny of nations, and on the progress of ages. As civilization becomes diffused, the literature of a country comes more and more into sympathy with ordinary life. Nor does literature lose anything by being thus brought into contact with common life; for those works are ever the best and most useful which speak to the feelings and sympathies of the great mass of the people. Too frequently, and too long, have literature and life been completely alienated from each other, like two distinct worlds, having no interests, no sympathies in common, to the great injury of both. Literature has been despised in the eyes of the world, and the world has been too much overlooked by men of letters. "The isolation of the learned, as a distinctive body," says Fred. Schlegel, "from the great mass of the people, is the most formidable obstacle in the way of national civilization. The various innate inclinations, nay, the very conditions and circumstances of men, should, to a certain extent, co-operate, if the productions of the mind are to be perfected or appreciated." "The products of the mind cannot really be said to have any other fertile soil in which to take root than those sentiments common to all noble-minded and God-seeking men, and with these the genuine patriotism and national reminiscences of a people, whose accents they breathe and whose welfare they are intended to promote." "It is curious among ourselves to trace the decline of the favourite amusements of our ancestors. The theatres are almost deserted by the ranks which used to frequent them. The public assembly-rooms of the rich, the suburban places of resort for nightly entertainments, once so common among the middle classes, are alike falling into comparative disuse. Of the increased infrequency of play, or even games of skill in society, every-one can judge. Of wine, the consumption has certainly not increased one half in a century, while the number of consumers has probably been quintupled or sextupled. All these things afforded a certain quantity of occupation, and the substitute for one and all has been the same,—*literature*."—(Brande's *Dictionary*.) One effect of this great spread of literature in the present day is to be regretted. The great demand upon the powers of distinguished men of letters, and the temptation to satisfy the cravings of the public, lead to the production of works not thoroughly matured; and hence there is in the literature of the present day a lamentable amount of loose thinking and careless writing; nor is there that proportion of works of an enduring nature that might be expected. The remarks that have been levelled at literature, as a profession, are no longer applicable to it. In this, as in any other walk of life, talent, industry, and perseverance will invariably command success.

LITHARGE. (*See* LEAD, OXIDES OF.)

LITHIASIS, *lith-i'-ă-sis* (Gr. *lithos*, a stone), in Med., is the disease of stone in the bladder or kidney (*see* CALCULUS). Also a disease of the eyelids, in which their margins are beset with small hard tumours.

LITHIUM, *lith'-e-um*, in Chem.,—symbol Li, equiv. 3·5, spec. grav. 0·59,—one of the alkaline group of metals, of which potassium, sodium, cæsium, and rubidium, are the other members. It closely resembles these metals in most of its properties, forming an alkali by its union with oxygen, decomposing water at ordinary temperatures, and having so low a specific gravity that it will float in the lightest known fluid. It is found in nature, in available quantities, in triphyline, petalite, and lepidolite; and from the experiments of Messrs. Bunsen and Kirchoff, it appears to be very widely distributed in minute quantities in mineral springs, soils, and the ashes of plants. The oxide lithia, LiO, forms a hydrate like potash and soda. It differs from them by being less soluble in water, by not deliquescing in air, and by acting on platinum at a high temperature. The salts of lithia are colourless. The *nitrate* is very soluble and deliquescent; the sulphate is soluble and forms fine crystals; the carbonate is sparingly soluble, giving an alkaline reaction. The chloride of lithium crystallizes

in cubes, and is very deliquescent and soluble in alcohol; therein differing from the chlorides of potassium and sodium. The salts of lithia, when exposed on platinum wire to the inner blowpipe flame, colour the outer flame a brilliant red. It will be seen from the above brief description, that lithia forms the connecting link between the alkalies and the alkaline earths. Lithia, and its salts, have remained without any practical value from the time of their discovery, in 1817, by Arfwedson, until a few years since, when Dr. Garrod introduced its use in cases of gout and stone. Its action on the uric concretions is much more rapid than that of the salts of potassium and sodium. It is generally exhibited in the form of aerated carbonate or effervescing citrate. Its name is derived from *lithos*, a stone, it having been found in the mineral kingdom only.

Lithography, *li-thog'-ră-fe* (Gr. *lithos*, a stone, and *graphein*, to write), an important branch of the art of printing, by which impressions can be taken from drawings or writing of any description, executed on stone with compositions of a greasy nature, termed lithographic chalk and lithographic ink. The process is a chemical one, based entirely on the antipathy which exists between water and oil, or grease of any kind, and which prevents them from entering readily into combination. This will be seen from the description of the method by which lithographic printing is effected; and as the impressions are taken from a plain and even surface, which is prepared to receive printers' ink in some parts and to reject it in others, it differs entirely from ordinary printing from movable type and wood-engravings, on the one hand, in which the impression is derived from projecting pieces of the original surface, between which spaces have been cut away by the graver,—and from printing from steel and copper-plates on the other, in which the impression is obtained from hollow lines that are sunk below the surface by the corrosive action of acid and by the etching needle and graver. The invention of the art is due to a German, Alois Sennefelder, who first practised it about 1795, and introduced it into Germany two or three years after. One of the first to whom he communicated his discovery was a gentleman of Frankfort, named André, who applied it with success to printing music. His son, Mr P. H. André, introduced the process into this country in 1801. He did not, however, take out a patent for the process, lest it should be discovered by the specification which he would be obliged to make. He brought out a series of lithographic drawings by West, Fuseli, and others; but the art did not obtain any decided success, owing to its capabilities not being sufficiently explained. Although the process was adopted at the War-office for printing rough maps and the plans of battles, it was not practised in England to any extent until about twenty years after its discovery, when it was brought into general use by Mr Ackermann, an artists' colourman and print publisher of celebrity. Since that time the process has been greatly extended and improved, and is now applied to the production of coloured prints, which can scarcely be distinguished from highly-finished water-colour drawings. The stone on which designs for lithographic printing are drawn is brought principally from Bavaria. It is a kind of calcareous slate, soft and porous, and of a pale grey or yellowish colour. It is dug from the quarries in large blocks, which are sawn or split into layers, varying from one inch to three inches in thickness; but great care is required in the operation, as the stone is of a brittle nature. To render them fit for the artist's use, the surface of the slabs must be made perfectly level and even, and this is done by rubbing or grinding the face of one stone on that of another,—a little fine sand, moistened with water, having been placed between them to facilitate the operation. Stones treated in this manner are said to be grained, a granulation having been produced on the surface which can be made either fine or coarse, as may be required. These are used in the production of prints, in imitation of drawings in chalk and pencil; but for the imitation of writing and etching, in which sharp and well-defined lines are required, and the production of prints in chromo-lithography, the surface of the stone must be rendered as smooth as possible, and polished, by rubbing it with pumice-stone and water. The lithographic chalk and ink which are used in the execution of drawings and writing on the stone, are both made of a mixture of tallow, white wax, soap, and shell-lac, which is coloured by the addition of a little lampblack, to allow the artist to see the effect of his work while the drawing is in progress. A little Venice turpentine is generally added to these ingredients when it is desired to produce lithographic ink, and there is some little difference in the proportions in which they are mixed for each composition respectively. The whole is melted and blended together over a slow fire, and the mixture is then poured into moulds, in which it is allowed to dry and harden for use. The chalk is moulded in the form usually adopted for crayons, and it is used in its dry state; but the ink is rubbed on a palette, like any ordinary water-colour, and applied to the stone by means of a pen or camel-hair pencil. The soap which is used in the above compositions causes them to be soluble in water, and when the design is completed, it must therefore be fixed on the stone. This is done by pouring a weak solution of nitrous acid over it, which has the effect of destroying the soluble nature of the composition by combining with the soap and neutralizing its properties, so that the chalk or ink is no longer liable to injury from the application of water to the stone. After this the stone is delivered to the printer, who damps the surface with water rendered slightly acidulous by the addition of a very small quantity of nitrous acid. As the stone is porous, all the parts which are untouched by the greasy ink or chalk imbibe the water readily; but the design remains perfectly dry, on account of the greasy nature of the composition with which it has been executed; since grease and water will not combine. A roller charged with printing-ink is now passed over the stone, and as oil enters largely into the composition of printing-ink, the ink will be absorbed immediately by every part of the design; but it will have no effect whatever on the wetted portions of the stone which are untouched by the chalk or ink, and will pass over them, leaving them perfectly clean and unsoiled. A piece of paper which has been previously damped is then laid on the stone, and an impression of the drawing or writing is obtained in the usual manner by the aid of a printing-press. Another method of preparing a stone for lithographic printing, is to cover the surface with a coating of gum-water coloured with a black or red pigment. The design is then executed with an etching-needle, which scrapes away the coating of coloured gum wherever it is applied, and allows the surface of the stone to appear through it, giving the drawing or etching the appearance of having been executed in white on a black or red ground, as the case may be. Oil is then applied to the stone, which readily imbibes it through the openings made in the ground by the etching-needle. After this the ground is washed off, and impressions are taken from the stone in the manner already described. Drawings executed in black and white on a tinted ground, or in three tints, as it is usually termed, are imitated in lithography by printing two impressions on the same piece of paper from two different stones. From one of these the design, which is drawn upon it with chalk in the usual manner, is obtained, and the tint is produced from the other by means of colouring matter, the parts which are to appear white in the impression having been scraped out before any impressions are taken from the stone. In printing from two or more stones, the printer must take care that the impressions register accurately, or fit exactly together; that is to say, that the imprint of the second and following stones, if more than two be used, as in chromo-lithography, may fall exactly on that part of the surface of the paper on which the imprint of the first has been received. In chromo-lithography (from the Greek *chroma*, colour) the process is similar; but each colour and tint required in the picture is imprinted from a separate stone. In the first place the design is traced on stone, in outline, and from this impressions are taken, which are transferred to other stones, and serve to guide those who are employed in preparing them for the work in hand in placing the various colours in their proper positions, so that the successive imprints may blend and harmonise together, and so produce a picture that is pleasing in its general effect when the

whole have been applied to the paper. Accurate copies of the outline having been transferred to as many stones as may be required, the lights and shadows of the drawing are produced on two of them, in what may be termed washes of sepia and neutral grey, and these form the second and third stones from which imprints are taken. Others are charged in the requisite parts with the primary tints that appear in the drawing and those that are necessary to modify these and blend them together. The sharp, dark, finishing touches, and the final coat, consisting of a sort of glaze or wash which softens and subdues the tints that have been already laid on, are placed on others, and the whole are applied to the paper in succession in the order required. It will be seen that the process is one which demands great nicety in its execution, and that the greatest skill and care are necessary in preparing the stones and insuring perfect accuracy of register, without which the picture produced would be entirely spoilt, as the edge of one colour would lap over and encroach on the space allotted to another, and the work would be blurred in tint and indistinct or ill-defined in outline. Trade circulars, and specimens of MS. and handwriting, which are often given in bi graphical works, are written in lithographic ink, · what is called transfer-paper, and the writing is afterwards transferred from the paper to the stone. The paper is unsized, but a thin coating of gum, prepared in a particular manner for the purpose, is spread over the side which is intended to be written upon. When the ink is dry, the paper is damped on the reverse side, and laid with the writing downwards on a polished stone. The moisture that has been applied to the back of the paper partially dissolves the gum, and the paper can be removed, leaving the gum and the writing beneath it upon the stone. The next step in the process is to wash away the gum, after which impressions can be taken from the stone in the usual manner I... pressions of maps, charts, armorial bearings for book-plates, and designs of a similar nature, are taken from engravings executed on steel or copper plates in lithographic ink, and transferred to polished stone while the ink is still wet. Maps printed in this manner are but little inferior to those which are printed from the plate itself, and they can be produced at a far cheaper rate, owing to the tediousness of the process of printing from plates compared to that of printing from stone. When the engraving is of small size, several impressions can be ranged side by side, in rows, and taken off at once by a single stroke of the press. When the work is very large, the transfer may be made to a plate of zinc instead of stone, as stones of considerable size are liable to break under the pressure that is brought to bear on them. The transfer is made and impressions are taken from zinc plates in the same way as from stone. On account of the substitution of zinc plates for stone, the term zincography is applied by some to this kind of printing from a plane metal surface. With regard to the preparation of drawings on stone, it should be remarked that stones should be selected that are perfectly free from flaws, and of a sufficient degree of hardness. They should also be free from scratches; and to secure similarity of texture throughout the work, the granulation of the stones should be uniform all over the surface for drawings in imitation of chalk and pencil. While executing the drawing, the artist should be careful to prevent anything whatever from falling on the stone, as many instances have occurred in which a good picture has been injured by allowing fragments of the chalk to fall on the stone while sharpening the crayon, or even specks of saliva; while some have been irretrievably destroyed by the imprint of the thumb or finger incautiously placed on the surface in handling the stone while the hand was warm. Stones that have been already used can be made available a second time by scraping off the original dr[illegible] and rubbing down the surface.—Ref. [illegible] pædia,—Arts and Sciences; [illegible] on Stone.

Lithomancy, *lith'-o-man-se* (Gr. *lithos*, a stone, and *manteia*, divination), is a species of divination performed by means of stones. In this way Helen is reported to have foretold the destruction of Troy.

Lithontriptic, *li-thon-trip'-tik* (Gr. *lithos*, a stone, and *tribo*, I wear away), in Med., was a term used to denote certain medicines which were believed to have the power of dissolving calculi in the bladder. They were chiefly preparations of alkalies, which, by correcting the acid state of the urine, tended to alleviate the pain; but experience has abundantly proved that they possess no power of breaking up or dissolving the stone. The term is now generally applied to such medicines as are useful in counteracting the formation of calculi.

Lithotomy, *li-thot'-o-me* (Gr. *lithos*, a stone, and *temno*, I cut), in Surg., is the operation of cutting into the bladder, in order to extract one or more stones or calculi from it. In the article Calculus we have already given an account of the nature and formation of these substances; and here we shall notice shortly the operation that is generally had recourse to in order to remove them. It is first of all necessary to ascertain the actual existence of the stone in the bladder, and that it is not encysted, or adherent to any portion of its substance. This is done by introducing a metallic instrument, called a *sound*, through the urethra into the bladder, by which the stone may be felt, and a sound produced by striking it. Several methods have been recommended of extracting the stone; but there are only two of them that can be adopted with any propriety: one of these is called the "high operation," from being performed immediately above the pubes. There are, however, several objections to this mode of operation, and it is now rarely adopted, except for some special reason, as where there is disease of the urethra. The other is called the "lateral operation," on account of the prostate gland and neck of the bladder being cut laterally. In this case the incisions are made in the perinæum, and the neck and lateral part of the bladder laid open, so as to allow of the extraction of the stone: it is to be removed by the finger if possible, and if not, by a forceps. Where large, it is sometimes necessary to crush the stone, and take it away piecemeal; in every instance the cavity of the bladder ought to be examined with the finger, to ascertain that there is no other stone present. Where numerous, they may be removed with a scoop; and if broken down, tepid water should be injected, so as to remove every portion of the calcareous matter, and prevent a nucleus remaining for the formation of a future stone. The after-treatment is simple; the wound is left open or only covered with some simple ointment, and in a dependent position, that the urine may flow freely through it. The patient is to be kept quiet, and on a low regimen, and diluent drinks administered; and any symptoms of inflammation are to be met by prompt antiphlogistic treatment. In the course of two or three days the urine begins to flow by the urethra, and is soon wholly discharged in that way.

Lithotrity, *li-thot'-re-te* (Gr. *lithos*, a stone, and *tero*, I break into pieces), in Surg., is the operation of breaking into pieces a calculus in the bladder by means of instruments passed into that organ through the urethra, so that the fragments may be discharged through the latter, and thus the performance of the operation of lithotomy rendered unnecessary. This is one of the great triumphs of modern surgery, and its introduction has taken place since the commencement of the present century. Various modes of performing the operation have been adopted, but the most approved is that of passing a pair of strong sliding forceps, furnished with teeth, through the urethra into the bladder, and laying hold of the calculus, when the lower limb of the forceps is fixed in a vice, and the upper struck smartly with a hammer, so as to break the stone. The instrument is then withdrawn, and the fragments are afterwards voided with the urine. If portions remain, the operation is repeated from time to time. This operation is so simple, attended with so little danger, and productive of so little pain, as to render it, where it can be used, immeasurably preferable to lithotomy. When the calculi are very large or very hard, it cannot be adopted.

Litmus, *lit'-mus*, in Chem., a blue colouring matter obtained from the *Roccella tinctoria*, and moistened with a solution of carbonate of potash The chemical character of this convenient test deserves investigation. It is much used by chemists as a rough test for the presence of free acid or alkali in a solution or gaseous mixture. It is generally used in the form

of litmus-paper, which is prepared in the following manner:—Common commercial litmus is digested in water until a deep-blue solution is formed. It is then filtered, and pieces of bibulous paper are dipped into it and dried. It often happens that the litmus itself contains alkaline matter; in which case it will be necessary to add dilute acid until the blue colour just begins to burn, when a few drops of the alkaline litmus solution should be added to restore the balance. Blue litmus-paper is burnt red by acids. Reddened by being suspended for a few seconds over the fumes of acetic acid, it serves as a test for alkalies, which restore it to its original colour. It is hardly necessary to direct the student to keep litmus-papers out of the reach of the light and acid or alkaline fumes. (For the rationale of the action of acids and alkalies on litmus, *see* SALTS. *See* also ROCCELLA.)

LITOTES, *li-to'-tees* (Gr.), in Rhet., is a figure of speech, wherein, by denying the contrary of what we intend, more is signified than we would seem to express. Thus, "a man of no mean ability;" meaning "of considerable ability."

LITRE. (*See* METRIC SYSTEM.)

LITTER, *lit'-ter*, a term applied in Agr. to the straw, fern, or other dry substances which are placed under horses and cattle, in the stables, cow-houses, farm-yards, &c., for the purpose of keeping the animals clean and warm, and providing a supply of manure. For this latter object all sorts of dry materials ought to be carefully collected and stacked for winter use. The term is also used to denote a brood of young pigs, puppies, kittens, and other quadrupeds. A vehicle formed with shafts, supporting a bed between them, in which a person may be borne by men or by a horse, is called a litter. In the latter case it is usually called a *horse-litter*; and a similar carriage in India is called a *palanquin*.

LITURGY, *lit'-ur-je* (Gr. *leitourgia*, from *leitos*, public, and *ergon*, work), denotes, in the original, any public act or service, whether of a sacred or secular nature. It afterwards came to be applied generally to the public service of God in the Church, and in this sense is frequently used in the Septuagint translation of the Old Testament. At a later period the term was restricted to the office of the holy Communion, and in this sense it is to be understood when we speak of the Liturgy of St. James, St. Chrysostom, &c. At the present day the word is employed to designate the ordinary prescribed service of the Church, either with or without the Communion office. In the first ages every bishop was at liberty to order the form of divine service in his own church; and accordingly each particular church or diocese had its proper liturgy. This privilege the bishops retained for several ages. Hence we find that in early times different liturgies were in use in different parts of this country; the cathedrals of York, Lincoln, Hereford, and Bangor, and even Aberdeen, in Scotland, having their respective uses. Christian liturgies are divided into three classes,—those of the Eastern, the Roman Catholic, and the Protestant churches. In the Eastern church several liturgies are in use. That ascribed to St. James is used by the church at Jerusalem, and may date as far back as the 2nd century; but many additions have been made in later times. The liturgy of St. Mark (Alexandrine liturgy) is ascribed to Cyril of Alexandria, and still forms the main part of the Coptic and Ethiopian liturgies. A third very important liturgy is contained in the Apostolic Constitutions, and has been ascribed to Clement of Rome; but modern investigations have shown that its origin must belong to a later period. The liturgies of Basil and Chrysostom are revisions of the liturgy of St. James, and are the main sources of the liturgy of the Russian church. The first beginnings of the Roman liturgy undoubtedly reach back to the time of the earliest bishops. In the Romish church the liturgy is divided into several books or offices; as the Breviary, containing the matins, lauds, &c.; the Ceremoniale, or office peculiar to the pope; the Missal, or office of the mass; the Pontificale, direct- [illegible] word liturgy is applied only to the office of the mass. Its history can be traced back as far as the middle or end of the 5th century. Gregory the Great made many additions to it, and gave it pretty much the shape that it now has. Pius V., in 1570, established it as *Missale Romanum*, which was revised by Clement VIII. and Urban VIII. The Ambrosian liturgy, which is used in the cathedral at Milan, is by tradition ascribed to Barnabas; but it takes its name from St. Ambrose, who made some changes in it. It differs from the Roman in form, but not in doctrine. The Mozarabic liturgy in Spain had undoubtedly a very early origin. It was approved by Isidore of Seville, and the fourth council of Toledo. The Gallican liturgy is that which was anciently in use in the Gallican church, and is said to have had Hilary of Poitiers among its authors. It was supplanted by the Roman liturgy introduced by Pepin and Charlemagne. The whole of the Roman liturgy is in Latin; those of Protestants in the vernacular of the different countries. In 1523 Luther drew up a liturgy or form of prayer and administration of the sacraments, which in many points differed but little from the mass of the Church of Rome. He did not, however, confine his followers to this form; and hence every country in which Lutheranism prevails has its own liturgy, agreeing with the others in essentials, but differing in many things of an immaterial nature. In recent times, Lutherans have begun to lay more and more stress upon the liturgical parts of divine service; and in many parts of the continent changes have been introduced in the liturgies which have given rise to violent controversies, those in favour of the changes being accused by their opponents of leaning toward the views of the Roman Catholic church. Calvin prepared no liturgy; but his followers in Geneva, France, Holland, and other places, drew up forms of prayer, of which the Genevese and the French are the most important. In Scotland, the Presbyterian churches make use of no liturgy. The most celebrated among the liturgies of the Protestant churches is that of the Church of England. The publication of Henry VIII.'s "Primer," in 1535, was one of the first steps in the reformation of doctrine and worship in this country. Two years later the Convocation appointed a committee to compose a book entitled "The Godly and Pious Institution of a Christian Man," containing a declaration of the Lord's Prayer, the Ave Maria, Creed, ten commandments, seven sacraments, &c. In 1545 a second Primer came out, and in 1547, the 1st of Edward VI., Archbishop Cranmer, Bishop Ridley, and eleven other eminent bishops and divines, were commissioned by the king to draw up a communion-service, and to complete the whole liturgy by adding public offices for Sundays and holidays, for baptism, confirmation, matrimony, burial, and other special occasions. Our excellent liturgy, thus compiled, was revised and approved by the archbishops, bishops, and clergy of both provinces of Canterbury and York, and then confirmed by the king and three estates in parliament, 1548. Some objections being taken to certain parts of it, it was ordered to be revised; and, in 1551, again received the sanction of parliament. These acts, however, were repealed in the first year of Queen Mary, who restored the Latin liturgies of the Roman church. In 1559, the first year of the reign of Queen Elizabeth, the act of repeal was reversed, and the former liturgy, the second book of Edward, was restored. It was, however, subjected to a further revision, by which some few passages were altered, and the petition in the litany for being delivered "from the tyranny of the bishop of Rome and all his detestable enormities," left out, in order that conscientious Catholics might not be prevented from joining in the common service. In the first year of James I. (1604) it underwent another revision, in consequence of a conference held at Hampton Court between some bishops and divines of the Church of England on the one side, and some Puritans on the other. The principal changes introduced were additions of some prayers and thanksgivings, and of that part of the Catechism which contains the doctrine of the sacraments. Some alterations were also made in the rubric relative to the absolution, to the confirmation, and to the office of private baptism, which was confined to the lawful minister, so as to prevent laymen from presuming to baptize. In this state it continued till the reign

of Charles II., who, in 1661, issued a commission empowering twelve bishops, and as many Presbyterian divines, to make such reasonable and necessary alterations as they should jointly agree upon, nine assistants being added on each side, to supply the place of any of the twelve principals who should happen to be absent. These commissioners had several meetings at the Savoy, but to very little purpose, as the two parties could not come to any agreement, some of the Presbyterians maintaining that it was too bad to be mended; and Baxter prepared one of his own, which he proposed in its place. The conference, therefore, broke up without anything being done, except that some particular alterations were proposed by the episcopalian divines, which, in the May following, were considered and agreed to by the whole clergy in convocation. The English liturgy was then brought into the state in which it at present stands, and was unanimously subscribed by both houses of convocation of both provinces on the 20th December, 1661; and being brought to the house of Lords the March following, both houses passed an act for its establishment. The English liturgy was adopted in Ireland shortly after the Reformation in England The English liturgy, says Bishop Jebb, "possesses a peculiar temperament, equally remote from all extremes, and harmoniously blending all excellencies: it is not superstitious, it is not fanatical, it is not cold and formal, it is not rapturous and violent; but it unites, beyond any other human composition, sublime truth and pure spirit, the calmest wisdom and the most energetic devotion." Liturgies, as a special branch of practical theology, have been divided into three parts; viz (1) Dogmatical, or an investigation into the nature and essence of liturgy (divine service); (2) historical, or the history of the various liturgies; and (3) practical, or the application of the results of the two former parts to the present condition of divine worship.

LIVER, *liv'-er* (Sax. *lifer*, Gr. *hepar*), in Anat, is the secreting organ or gland, by which the bile is formed. It is situated in the right hypochondriac and epigastric regions, below the diaphragm, and is of a reddish-brown colour. Its form is irregular, being convex on the upper surface, irregularly concave below, very thick behind, and very thin in front, and in the adult it generally weighs from three to four pounds. It is divided into two principal lobes, the right and left,—the former of which is by much the larger. They are divided on the upper side by a broad ligament, and below by a considerable depression, or fossa. Between and below these two lobes is a smaller lobe, called lobulus Spigelii. To the left it has the fissure for the lodgment of the ductus venosus; on the right, the fissure for the vena cava. The lobulus caudatus is a tail-like process of the liver, stretching downwards from the middle of the right lobe to the lobulus Spigelii. The liver, like the other viscera of the abdomen, receives an investment from the lining membrane of that cavity,—the peritoneum, which being reflected from it at different points, forms broad bands, connecting the liver with the surrounding parts. An investment of areolar tissue is also spread over the organ, extending into the interior, and forming thin but dense sheaths to the vessels and canals, called the capsule of Glisson. The blood-vessels of the liver are the hepatic artery and veins, and the vena portæ; the lymphatics are numerous, and the nerves are supplied from the pneumogastric and phrenic, and the hepatic flexus. The proper tissue of the liver is composed of a great number of granular bodies, of the size of millet, and called lobules, of a foliated appearance. The liver thus receives two kinds of blood,—arterial, by means of the hepatic artery, in small quantity, destined principally for the nourishment of the gland; and venous, by the vena portæ, in much larger quantity, from which the bile is principally formed. The tributary branches, by the junction of which the main trunk of the portal vein is formed, comprise the veins which receive the blood from the stomach and intestinal canal, the spleen, pancreas, and gall-bladder. From these various sources, then, venous blood is poured into the liver by the vena portæ, which divides and subdivides, like an artery, till it reaches the interlobular spaces, forming a freely anastomosing network throughout the organ, and constituting the interlobular veins. From these interlobular veins proceed, on every side, minute capillaries, which form dense networks, that seem to make up nearly the whole substance of the lobules. Through the capillaries the blood passes into *intra*-lobular veins, of which one, with its outspread branches, occupies the centre or axis of each lobule; and these intralobular veins, by successive junction and conflux, make up the trunks of the hepatic veins, by which the blood of the portal vein, after secreting the bile, is carried from the liver. The secretion of bile (*see* BILE), though the chief and most obvious of the functions of the liver, is not the only one which it has to perform; for recent discoveries have shown that important changes are effected in certain constituents of the blood, in its transit through this gland, whereby they are rendered more fit for their subsequent purposes in the animal economy. From the labours of M. C. Bernard, it appears that the low form of albuminous matter conveyed from the alimentary canal by the blood of the portal vein, requires to be submitted to the influence of the liver before it can be assimilated by the blood. The liver also possesses the remarkable property of forming sugar out of principles in the blood which contain no trace of saccharine or amylaceous matter. The excretory apparatus of the liver consists of the hepatic, common, and cystic ducts, and the gall-bladder. The biliary ducts commence by small twigs in each lobule, and join, forming, where they emerge from the gland, the hepatic duct. This duct, after passing down for a short distance, is joined at an angle by the cystic duct from the gall-bladder. The common duct thus formed is called the ductus communis coledochus, and empties itself into the duodenum. The retention of the materials of the bile in the blood acts like a poison upon the nervous system, and if the suspension of secretion is complete, death soon takes place. Much of the cerebral disturbance accompanying dyspepsia, some forms of which are popularly known as "liver complaint," is doubtless due to deficiency of the biliary secretion, and the non-elimination of certain deleterious constituents. (For diseases of the liver, see BILE, BILIOUS, DYSPEPSIA, HEPATITIS, &c.)—*Ref.* Todd's *Cyclopædia of Anatomy and Physiology;* Carpenter's *Physiology;* Budd's *Treatise on Diseases of the Liver.*

LIVER OF SULPHUR, in Chem, a brown-red mass, sometimes used in medicine, prepared by fusing two parts of carbonate of potash with one of sulphur. It is a compound, composed of tersulphide of potassium, hyposulphite of potash, and sulphate of potash.

LIVERWORT. (*See* HEPATICACEÆ.)

LIVERY, *liv'-e-re* (Fr. *livrée*), is applied to the distinctive dress given by masters to their male servants. It is said to be derived from the custom of the early kings of France of presenting to the servants throughout the palace particular sets of clothes at the royal expense. In the days of chivalry, livery was not any mark of degradation; for the duke's son wore a prince's livery; the earl's son a duke's; and so on. Cavaliers distinguished themselves at tournaments by wearing the livery or badges of their mistresses. For a considerable period, the "retainers" of noblemen wore their masters' livery. Their service lasted for one year; but so formidable did this body become, that no nobleman was at length allowed to retain such followers without license. Licenses and retainers were alike abolished in the reign of Charles II., and, since that period, livery has only been worn by the lower class of male household servants. The coachman is the recognized chief of the liveried corps. A servant in livery is addressed by his Christian name; but when promoted from the servants' hall to the steward's room company, he is distinguished by his surname. The word livery is also applied to the ninety-one companies of the city of London, the members of which wore habiliments in form and colour resembling those of the lord-mayor and sheriffs.—Ref. *Encyclopædia Britannica.*

LIVERY, in Law, has several significations. It was applied to a delivery of possession to those tenants who held of the king *in capite*, or by knight's service. It was also applied to the writ which lay for an heir to obtain the possession or seisin of his lands at the king's hands. By 12 Car. II. c. 24, all wardships,

liveries, &c., are taken away. *Livery of seisin* is ceremony in the common law, used in the conveyance of lands, tenements, and hereditaments, where an estate in fee simple, fee tail, or other freehold, passeth It is a testimonial of the willing departing of him who makes the livery from the thing whereof the livery is made, and of willing acceptance of the other party receiving the livery. This livery of seisin is no other than the pure feudal investiture or delivery of corporeal possession of the land or tenement, which was held absolutely necessary to complete the donation. By the common law, it was necessary to be made upon every grant of an estate of freehold in hereditaments corporeal, whether of inheritance or for life only but by 8 & 9 Vict. c. 106, it is declared that after the 1st day of October, 1845, all corporeal tenements and hereditaments shall, as regards the conveyance of the immediate freehold thereof, be deemed to lie in grant as well as in livery. Livery of seisin is of two kinds,—in deed, and in law; the former being an actual delivery of some symbol of possession on the land with apt words, the latter a verbal delivery within sight of it. Livery in law does not transfer the freehold till an actual entry is made by the feoffee; and hence, if either the feoffor or feoffee dies before an entry is made under the livery thus given, it becomes void. (*See* FEOFFMENT, GRANT, SEISIN.)

LIVERYMAN, means a freeman of the city of London admitted number of some one of the numerous city companies or guilds; by which right of entrance he enjoys certain privileges and powers. The common councilmen, sheriffs, and similar superior officers of the city, are elected from the mass of liverymen.

LIVING, *liv'-ing* (from Sax. *libban*, to live), a benefice, or an ecclesiastical estate, which is granted to some priest or clergyman for term of life, to be enjoyed by him on account of his ministry in the Church

LIVRE [illegible] *libra*, pound), a French coin now not much in use, and equal in value to [illegible] centimes, it is consequently slightly less in value than a franc, 81 livres being equivalent to 80 francs. But still, the franc of the present day is identical with the *livre* of old, its name having been changed at the revolution of the last century.

LIXIVIATION, in Chem, a process of separating the soluble from the insoluble portions of compounds by steeping and washing in water. The extraction of the soluble salts contained in kelp is an example of lixiviation. The solution so formed is termed a ley or lye.

LIZARD. (*See* LACERTINIDÆ.)

LLAMA, or GUANACO, *la'-ma*, a genus of animals belonging to the class *Mammalia*, ord. *Ungulata*, fam *Bovidæ*, and tribe *Camelina*. The llama bears a strong resemblance to the camel, and may be looked upon as the representative of that animal in the New World, being confined to South America. Their teeth are very similar to those of camels, but their backs are not furnished with humps; their tails are short and hairy, their toes slender, and their soles narrow and separated in front. In Peru, where they are principally found, they live in a wild state, in herds of sometimes one or two hundred. The ancient Peruvians, however, completely subdued and domesticated the llama as a beast of burden; and to them it answered all the purposes of the camel or dromedary of the Old World. In a wild state, the herd keeps a careful look-out, and when disturbed gallops off with great rapidity. There are two distinct species found in South America,—the *Lama vicugna* and the *Lama guanacus*. They both inhabit the Peruvian Alps, the Pampas, and the mountains of Chili, extending as far as the Straits of Magalhaens. The former animal, the vicuna, is principally found in the most elevated land and mountains of Bolivia and Chili. This species is quite wild, and hitherto has defeated all attempts of the aborigines to domesticate it; and has an awkward habit of jumping and kicking with its hind legs. The guanaco is the characteristic quadruped of the plains of Patagonia, and is very common over the whole of the temperate parts of South America. They live in herds, but are easily d[illegible] being caught. In their habits they resemble a flock of sheep, and, when caught, appear to have no idea of defending themselves. Two other species of llama, which are thoroughly domesticated, are also mentioned by travellers,—the *L. glauca*, which is of a whitish colour, and has long slender legs; and the *L. Pacos*, which is of a blackish hue, and has short legs. The wool of llamas is made into cords and sacks as well as into stuffs for ponchos, &c.; and in Mexico the bones are converted into instruments for weaving the wool. The dung is also used for fuel The llama is, however, rapidly disappearing, and its place is being supplied by the more useful and profitable European sheep.

LLOYD'S LIST, *loyds*, a publication in which the news received at Lloyd's Rooms, with reference to shipping and the quotations of foreign prices, is published. On account of the extensive information which it contains, it is of the greatest use to merchants and others engaged in foreign trade. It has been in existence ever since the year 1716, from which time its merits have been fully recognized.

LLOYD'S ROOMS, a portion of the Royal Exchange devoted to the use of shipping-agents and insurance-brokers. Meetings of traders used formerly to take place at the coffee house kept by one Mr Lloyd, in Cornhill, and consequently the name was applied to that portion of the Exchange dedicated to the purposes stated above. Lloyd's Rooms are kept up by the subscription of the frequenters, and they are stored with much valuable information with reference to maritime interests.

LOADSTONE. (*See* IRON and MAGNET, NATURAL.)

LOAM, *loam* (Sax. *lam*), a term generally applied to a dark-coloured rich mould, principally composed of dissimilar particles of earth and decomposed vegetable matter. Loam is moderately cohesive, and therefore neither retentive of moisture, like clay, nor too ready to part with it, like a sandy soil. It is a continued source of carbonic acid, as almost every particle of it is surrounded by an atmosphere of that gas, which is absorbed by the roots of plants, and replaced by atmospheric air, to be again converted into carbonic acid. Upon this transformation, the influence of loam on vegetation may be readily understood: it does not itself nourish plants, but it presents to them a slow and lasting source of carbonic acid which is absorbed by the roots.—*Ref.* Johnson's *Farmer's Encyclopædia*.

LOAN, *lone* (Sax. *lænan*, to lend), in Law, is a contract by which the use of anything is given under condition of its being returned to the owner. A loan is said to be gratuitous when the borrower receives the thing for his own benefit, without payment of hire or reward to the lender. There are two kinds of gratuitous loans,—the one called *mutuum*, for use and consumption, an equivalent in kind to be returned; the other a *commodatum*, which is the loan of a specific thing, to be used and returned *in individuo*. In loan by way of mutuum, the parties stand in the relation of debtor and creditor to each other; in loan by way of commodatum, they are known in law as borrower and lender. A loan of money is a mutuum; of a horse or book, a commodatum. It is of the very essence of a commodatum, that the loan be gratuitous; for if anything be paid for the use of the chattel, then the contract is one of letting and hiring. In a loan by way of mutuum, the chattel lent becomes the absolute property of the borrower, to do what he pleases with it, and to use it in any way he thinks fit; but in loan by way of commodatum, the temporary right of possession and user only is transferred, and the borrower is consequently obliged to render back the identical thing lent. As regards the borrower, he has a right to receive and hold the thing borrowed; but only as the property of the lender. For many purposes, he is, in the eye of the law, in the position of owner; and certain of the rights of an owner are conferred upon him, as against every one but the owner. The borrower has a right to use the article borrowed, but only to use it. He has no more right to lend it than he has to give it away or sell it. He is expected to take as much care of it as if it were his own property under the like circumstances, and is liable for any damage arising from even slight negligence. He is, however, not liable, if the thing be lost through no imprudence or negligence of his. The borrower is not liable for such injury as naturally results from the use of a thing; but, on the other hand, he is bound to pay all the expenses or charges which naturally result from or accompany the use. A lender has no right to compensation for loss through want of the care or skill which he had no right to ex-

THE DOMESTIC LLAMA.

pact. If he lends a thing for an illegal act, he is no longer a lender in the eye of the law, but an accomplice in the wrong done. If the thing lent be used according to the purpose for which it was lent, and is lost or perishes, not through the default of the borrower, then the owner shall bear the loss. If it be used in any other manner than according to the lending, then in whatever manner it may perish, if it be not by default of the owner, then the borrower shall be liable for the loss. Thus, if a horse is lent for an ordinary ride along the high road, and the borrower takes it off the high road into wet and slippery ground and the horse slips and breaks his knees or is otherwise injured, then the borrower must make good the loss. If the borrower keeps the thing borrowed after it is his duty to return it, or after a reasonable time after it has been demanded, then his relation to the lender changes totally, and he becomes liable for any loss or injury that may occur, although wholly without his fault. The borrower has no right to detain the thing borrowed for any antecedent debt due to him, nor can he set up a right to detain the chattel for payment of necessary expenses incurred by him in the keeping and preserving it. In the case of a mutuum, the borrower is bound to restore at a time agreed upon, or within a reasonable period after request, an article of the same kind and quality as the one originally lent to him. This is essential to the character of a mutuum, for if by agreement an article of different kind is to be returned, then the contract is not a mutuum, but an exchange or sale. As the right of property is transferred by mutuum, so is also the risk of loss; and hence if the thing borrowed is destroyed before it can be used, the borrower is nevertheless bound to pay to the lender the equivalent which he owes at the time appointed. Such is loan in its strictly legal signification; but, in common phraseology, the term is used even when compensation is included, which legally comes under the designation of hiring. Money lent at so much per cent. is also called a loan. A loan of money to be used for hire is a loan for use and consumption, the identical thing lent not being intended to be returned, but its equivalent in value and kind.

Loan, Public, is the name given to money borrowed by the state, which constitutes the national debt. (*See* National Debt.)

Loasaceæ, *lo-a-sai'-se-e*, in Bot., the Chili-nettle fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciflora*. Herbaceous plants with stiff hairs, which are sometimes stinging. Leaves without stipules; calyx superior, 4 or 5-parted, persistent; petals 5 or 10, in 2 whorls, often hooded; stamens numerous, in several whorls, either distinct or united in bundles; ovary inferior, 1-celled, with several parietal placentas, or 1 axile placenta; style 1; ovules pendulous, anatropal. Fruit capsular or succulent. Seeds having an embryo lying in the axis of fleshy albumen. The *Loasaceæ* are all natives of North and South America. Several species are cultivated on account of the beauty of their flowers. A Mexican species, *Mentzelia hispida*, possesses a purgative root, which has been used medicinally.

Lobe, *lobe* (Lat. *lobus*), in Anat., is a term applied to the more or less separate parts of which the glands of the body are composed. Thus we have the lobes of the brain, lungs, liver, &c. Lobe is also applied to that pendent portion of the ear which is more fat and fleshy than any other part.

Lobelia, *lo-be'-le-a* (in honour of Lobel, a botanist), in Bot., the typical gen. of the nat. ord. *Lobeliaceæ*. The most important species is *L. inflata*, Indian tobacco, a native of North America. The flowering herb and seeds have been extensively employed, especially in America, for their sedative, antispasmodic, emetic, and expectorant effects. Lobelia resembles tobacco in its action, but requires to be used with care, as several fatal cases of poisoning have resulted from its empirical use. *L. syphilitica* is reputed to be efficacious in syphilis; *L. urens* has blistering qualities.

Lobeliaceæ, *lo-be-le-ai'-se-e*, in Bot., the *Lobelia* fam., a nat. ord. of *Dicotyledones*, sub-class *Corolliflora*. Herbs or shrubs, with a milky juice. Leaves alternate and exstipulate; calyx superior; corolla monopetalous, irregular, and valvate; stamens 5, syngenesious; ovary inferior, 1—3-celled; placentas axile or parietal; style 1; stigma surrounded by a fringe of hairs. Fruit capsular, dehiscing at the apex. Seeds numerous, albuminous. The plants of this order should generally be regarded with suspicion, as many act as acrid poisons. They are chiefly natives of tropical and sub-tropical regions. There are 29 genera and 375 species.

Lobster, *lob' ster* (Ang.-Sax.), (*Homarus vulgaris*), a crustaceous animal belonging to the ord. *Macroura*, and fam. *Astacidæ*. When alive, its general colour is a bluish-black, beautifully variegated with paler spots and clouds. Its thorax is smooth, its snout short and serrated, and it has very long antennæ, with two shorter bifid ones between them. The claws and fangs are large, the greater being tuberculated, and the lesser serrated on their anterior edges. It has four pairs of legs; the tail has six joints, and the caudal fin is rounded. The two great claws of the lobster form its instruments of provision and weapons of defence; they open and close like a pair of nippers, and are very strong. The head of the lobster is small, and furnished with two eyes, which are projectile or retractile at will. The mouth resembles that of an insect, opens longitudinally, and is furnished with two teeth for the mastication of its food, and between them is a fleshy substance shaped like a tongue. When the young leave the parent lobsters, they seek the minute crevices of the rocks and other secure places, and in a few weeks they acquire hard, firm shells. Lobsters, like crabs, change their shells every year; previous to this process they appear sick, languid, and restless, and lie torpid and motionless. Three or four days are required before they acquire their new shells, and during that period they are defenceless, and become the prey, not only of fish, but also of such of their own species as are not in a similar condition. While in a soft state lobsters increase in size; and in comparing the dimensions of an old shell with a new, the latter is found to be one-third larger than the former. When boiled, the lobster becomes red. In a commercial point of view, the lobster is perhaps the most important of all the crustaceans, on account of the esteem in which it is held as an article of food. 150,000 are annually sent to Billingsgate market from the coast of Scotland and the Orkney and Lewis Islands; 600,000 annually arrive there from Norway; and it is not uncommon to see 20,000 to 25,000 lobsters in the market in one day. They are principally sent to London during the period between March and August. According to most accounts, they are very stationary in their habits, and differ in colour and appearance in the different places where they are taken. They are caught in pots, similar to those used in the capture of crabs. Lobsters very readily part with their large claws; and, when seized by one of them, the animal gives it up at once. When suddenly alarmed by a peal of thunder, or the report of a cannon, they shoot their claws immediately. Considerable time elapses before the lost member is restored, and attains the size of the old one.

LOBSTER.

Local, *lo'-kal* (Lat. *locus*, a place), is applied to something supposed to be tied or annexed to some particular place. Thus, in Law, real actions are local, and require to be brought in the county where the lands lie; but a personal action, as of trespass or battery, is transitory, not local; and it is not material that the action be brought in the same county where the fact was done. A thing is also said to be local that is fixed to the freehold. Local customs are customs peculiar to some particular lordship or other district, and differing from the general customs of the country.

Location, *lo-kai'-shun*, in Law, is a contract by which a hire is agreed to be given for the use of anything, or for the labour of any person.

Lock, *lok* (Ang.-Sax.), a well-known instrument, used for fastening doors, chests, &c. It may be defined as a kind of fastening, which is only intended to be opened by one particular instrument, called the *key*, or by some secret mode of manipulation. In smith-work the lock is considered the masterpiece, as a great deal

of art and delicacy is required in contriving and varying the wards, springs, bolts, &c., and adjusting them to the places where they are to be used, and to the several occasions for using them. The earliest lock of which the construction is known, is the Egyptian, which was in use 4,000 years ago. It was so made that three pins dropped into three holes in the bolt when it was pushed in, and so held it fast. They could be raised again by putting in the key through a large hole in the bolt, and raising it a little, so that the pins in the key pushed the locking pins up out of the way of the bolt. This lock had very little security, for it was easy to find the places of the pins by inserting a piece of wood covered with clay or tallow, on which the holes marked themselves; and the depth could be easily ascertained by experiment. The Chinese lock is very superior to the Egyptian, and is founded on the same principles as the Bramah lock, which was regarded for a long time as the most secure lock ever invented. Until about eighty-five years ago, there were no locks in England so good as the Chinese lock, which was provided with sliders or tumblers of different lengths, and could not be opened unless they were all raised to the proper heights, and no higher. The locks used in this country were simply a mere bolt, held in its place, either shut or open, by a spring, which pressed it down, and so held it at either end of a convex notch. The only impediments to opening these locks were the wards, which the key had to pass before it could turn in the key-hole. The shape of these wards, however, could always be ascertained by inserting a blank key, covered with wax. Thus, a small collection of skeleton keys was all that the lock-picker required. The principle of all modern locks is the application of a lever to an interior bolt, by means of a communication from without; so that, by means of the latter, the lever acts upon the bolt, and moves in such a manner as to secure firmly the door or lid from being opened by any push or pull from without. The security of locks, therefore, depends upon the number of impediments which can be interposed between the lever,—that is the *key*, and the bolt. These impediments are generally known by the name of wards, but, as we have observed above, they can be opened by a mechanic of equal skill with the lockmaker without the key, unless some further obstacles be added. Various complicated and difficult locks have been invented within late years. The first step in advance was the use of tumbler locks. In these the bolt, although shot backwards and forwards, has no spring or notches to catch on the back rim of the lock, to hold it in any required position; but it is furnished with two notches in its upper edge. Behind the bolt is a piece of metal, called a *tumbler*, pivoted to the plate of the lock, and continually forced down by a spring, which presses on its upper edge. Near the end farthest from the pivot, the tumbler carries a projecting stud, which, when the bolt is fully shot, drops into one of the notches, and holds it firmly, until, by the application of the key, the tumbler is lifted up. By this action the bolt is released, so that the further turning of the key moves the bolt, till the stud falls into the other notch; thus securing the bolt either when locked or unlocked. The Chinese lock, before mentioned, may be looked upon as an example of the tumbler-lock. Notwithstanding the antiquity of the tumbler principle, its first important application in this country was by Barron, who patented his lock in 1778. In the simple form of the single tumbler just described there is this disadvantage, that whilst it effectually prevents the removal of the bolt unless the tumbler be raised high enough, it presents no impediment when the tumbler is raised beyond the proper degree. In Barron's lock this defect was remedied by the use of several tumblers each of which required to be raised to a different degree, and if any one of them were raised too high, it formed as effectual a barrier to the movement of the bolt as if it were not lifted at all. The next lock of any importance was the celebrated lock originally patented by Mr. Joseph Bramah, in 1788. Bramah came up to London from Barnsley as a joiner, and raised himself to eminence by the invention of this lock, of the machine for numbering bank-notes, the beer-engine, the water-closet, ever-pointed pencils, and the hydraulic press. In the Bramah lock the use of tumblers is applied in a very different manner to that described in Barron's lock, and the use of wards is entirely abandoned. The ordinary method of shooting the bolt by the action of the bit of the key is also abandoned; a stud attached to the end of a cylindrical barrel mounted in the lock, performs the office of the end of the bit. The Bramah lock consists of an outer barrel, which is screwed to, or cast with, the lock-plate, with a cylinder or inner barrel turning within the other. The security of the lock depends upon a number of sliders made of plates of steel doubled and sprung open a little, so as to make them move with a little friction in the slits of the cylinder or revolving barrel in which they lie; they are pressed up against the cap of the lock by a spiral spring. A deep groove is cut round the barrel, and in each of the sliders is a deep notch which can be pushed down to that place in the barrel by a key slit to the proper depth. When all the sliders are pushed down to that position, the barrel presents the appearance of having no sliders in it. At the place where the groove is, a steel plate made in two pieces, so as to get it on, embraces the barrel; it is provided with notches corresponding to the sliders, and is affixed to the body of the lock by screws. When pushed up by the spring, the sliders fill the notches in the plate and prevent the barrel from turning; but when they are pushed down by the key, the notches in the sliders all lie in the plane of the plate, and so the barrel can turn with the key, and the pin in the end of it turns the bolt. For many years the construction of Bramah's lock remained the same, and it was long considered a lock that could not be picked. It was clearly proved, however, that by the tentative process, as it is called, any lock can be picked,—that is, by cautiously trying one tumbler after another till they are all freed. Proceeding in this way, Mr. Hobbs, in 1851, opened the challe[illegible], which had hung in the [illegible] Bra[illegible]tablishment for years, in the short space of nineteen hours; and he would have done it sooner had not one of his instruments broken in the lock. He afterwards repeated the operation three times within the hour, before the arbitrators. It is a mistake to suppose that impressions cannot be taken from a Bramah lock. Cotterill's lock is on the same principle as Bramah's, the difference being that the sliders, in Cotterill's, are pushed out radially by a very thick key with inclined slits in it. Letter-locks, which were in use some years ago, could only be opened by setting a number of rings or discs to a particular combination of letters. It was generally supposed that these locks could not be opened by anybody; they were also called puzzle-locks. Afterwards it was found that they, too, could be readily opened by the tentative process. Chubb's locks have enjoyed more celebrity than all the locks which have been made on the many-tumbler principle invented by Barron. Their success arose partly from their superior workmanship, and use of more tumblers than usual, and from having applied the name "detector" to a certain part of the machinery, thus captivating the public with the idea of discovering whether any one had been tampering with the locks. The "detectors," however, were not able to withstand Mr. Hobbs's mode of picking locks. Amongst the principal inventions in tumbler-locks since 1851, may be mentioned Hobbs's locks, Parnell's locks, and Restell's lock. Another series of locks are those in which the tumblers or sliders are not moved one way by springs, and the other way by the key. The tumblers, or sliders, or discs, which stop the bolt, are kept in their places by friction only, and will stand anywhere, having their plates lying between them, and being pushed or turned one way in locking, and the other way in unlocking. Amongst these may be enumerated Andrew's American lock and Tucker's lock on the disc principle. A set of locks is frequently so arranged for convenience, that the key of one will open none of the others, yet there may be one master key which is able to open them all.—For further information on the subject of locks, the reader is referred to a comprehensive article on the subject by Mr. E. B. Denison, Q.C., in the *Encyclopædia Britannica*.

Lock. (*See* Canal.)

Locked Jaw. (*See* Tetanus.)

Locker, *lok'-er*, a sort of box or chest made along the sides of ships, for the purpose of stowing away

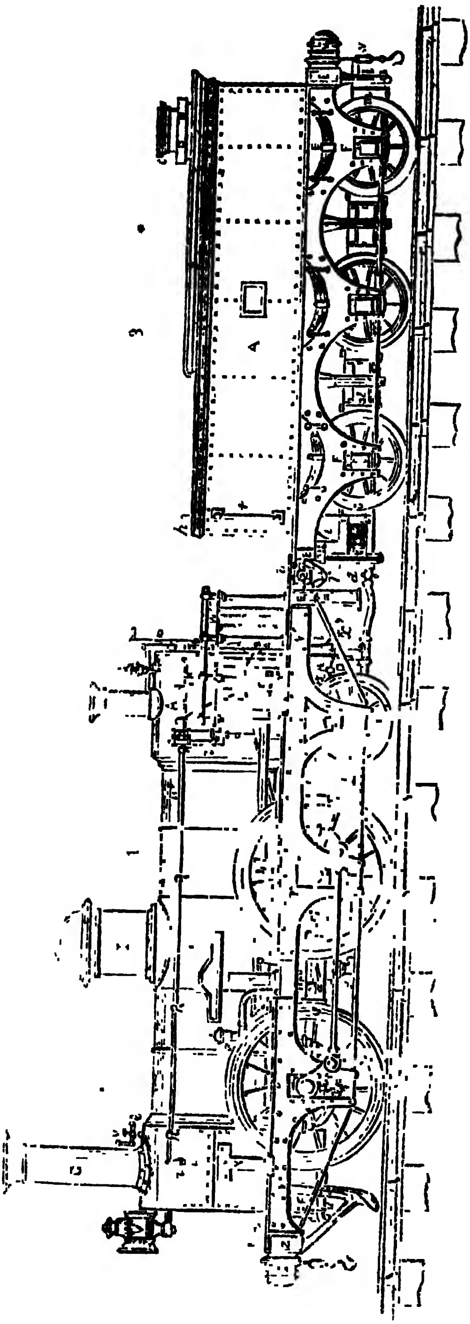
various articles. They are built, as it were, into the ship, and have their various names; as *bread-locker*, &c. The shot-lockers are racks made of strong plank, and put in the hold near the pump-well, where the shot is kept.

Locofoco, *lo'-ko-fo'-ko* (probably from Lat. *loco foci*, instead of a fire), a term applied to the ultra-democratical or Tory party in America. Lucifer-matches are termed locofocos in America, and the application of the word to this particular political party arose thus — In 1834, a certain number of the extreme democratical party met at Tammany Hall, New York, and there happening a great diversity of opinion, the chairman left his seat, and the lights were extinguished, with a view to dissolve the meeting; but those in favour of extreme measures produced locofoco matches, rekindled the lights, continued the meeting, and accomplished their object.

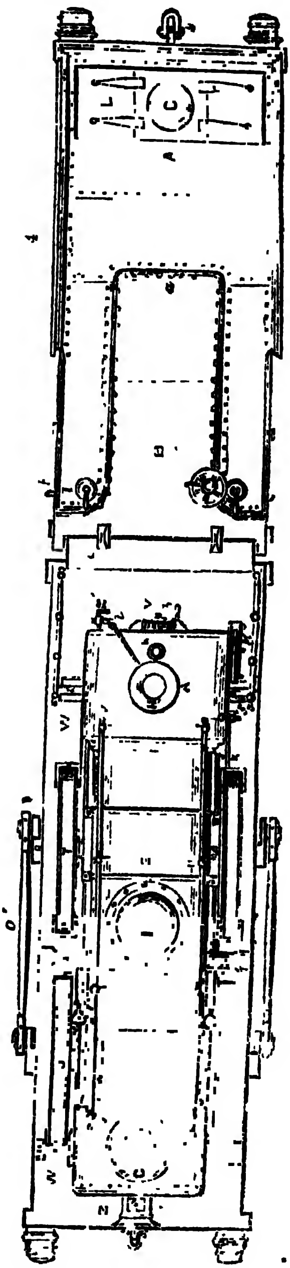
Locomotive Engine, *lo-ko-mo'-tiv* (Lat. *locus*, a place; *moveo*, I move), a steam-engine employed to draw loads in transport overland, especially on railways. The employment of steam as a locomotive power dates from a later period than the general application of steam to nearly all other mechanical pur[illegible] Many fruitless [illegible]ttempts were m[illegible] to [illegible] engines which [illegible]uld work on the common [illegible] [illegible]ls, but it soon became apparent that loco[illegible] could only succeed on the most perfectly prepared railways. In the mining districts, railways of wood and iron had long been in existence, and of these the steam locomotives at once took possession. In 1804, Richard Trevethick made and patented the first steam locomotive, which ran on a railway near Merthyr Tydvil. This engine in several respects resembl[illegible] those which have since been used for a like purp[illegible] both in form and structure. The cylinder was laid horizontally below the front of the body, or boiler, with its rod proceeding backwards, and continued by another rod, jointed to it, working the crank in the middle of an axle having a fly-wheel, and on the same axle, two cogged wheels, driving two others on the axle of the hinder [illegible]porting wheels, by whose resistance alone against the [illegible]ls, which were of iron, the engine was urged along, drawing ten tons, in addition to itself, at the rate of five miles an hour. Under the notion that smooth rails and wheels could not be depended on to drive a carriage, in 1811, a toothed iron rail and driving-wheel were patented, but failed, on account of the great wear and tear. It was, however, soon proved that the weight of an engine must always [illegible] wheels to the rails hard enough to insure their advancing without slip, even when drawing a train of [c]onsiderable weight. In 1814, an eng[illegible] [illegible]structed by Mr. George Stephenson, which was considered the most perfect that had been made for many [illegible] In this locomotive were two cyl[illegible] cylindrical boiler; it worked two pair of wheels by cranks, placed at right angles, so that when one was in full operation the other was at its *dead points*. By this means, the propelling power was always in action The next stimulus which the progress of this inven[t]ion received, was when the Liverpool and Manchester Railway Company had completed their line. Their railroad vastly exceeded all former roads in amount of artificial levelling and high finish, and the company offered a premium of £500 for the production of the best locomotive. In October, 1829, the prize was awarded to George Stephenson, whose "Rocket" attained a speed of 12½ miles with thrice its [illegible] and of 29 miles when alone. T[illegible] its construction all those mechanical arrange[ments] [illegible] which the extraordinary speed of the locomotive [illegible] of the present day is due. The success of this engine at once introduced the idea of *railway travelling*, such roads having previously been regarded as only for the carriage of goods. The principal requirement in a locomotive engine is *compactness*, and the production of the largest amount of power in the smallest amount of space. Hence, no idea of a condensing apparatus has ever been applied, the steam being merely expelled from the cylinders into the air; since the power has to be obtained from the smallest amount of machinery that will afford it, and not from the least *fuel*. The principle introduced by the "Rocket" boiler, which constituted the superiority of that engine, was the carrying of the heat from the furnace through the water by numerous small parallel flues, or rather tubes. By this means the surfaces by which the heat was communicated were numerously multiplied. The locomotive boiler is a flat cylindrical body, laid horizontally, with flat and vertical ends and a nearly cubical addition of its own breadth depending from the hinder part and containing the fire-box. The furnace or fire-box is a square box formed of two casings, the one within the other, with a space between them to contain water, and communicating with the interior of the boiler. Above the fire-box, and communicating with the upper part of the boiler, is a sort of bell-shaped receiver, covered at the top and opening into the boiler. A pipe opening into this receiver by a knee-joint, traverses horizontally along the whole of the upper part of the boiler. At its further extremity it opens into two pipes of smaller bore; these are bent downwards in order to supply the cyl[inders]. The hot air and smoke pass from the fire-[illegible] [illegible]h the tubes in the interior of the boiler and pass out at the funnel. There are generally two safety-valves, one being of the steelyard kind; but instead of the pressure being regulated by a movable weight, it is regulated by a spiral steel spring, the elastic force of which is measured on a graduated scale. The other [illegible] [a]cts in a similar way, but is protected [illegible] driver; so that if the first valve is too heavily weighted or will not act, the second valve will. The engine is a high-pressure one, and is provided with two cylinders, which lie in a nearly horizontal position, being a little inclined upwards towards the fire-box or back of the carriage. By the alternate motion of the piston-rod, motion is given to a crank on the axle of the back wheels, and thus the carriage is propelled. Levers for putting on or off the steam, and also for working the eccentrics that cause the carriage to move either backwards or forwards, are placed at the end of the fire-box, in a convenient position to be used by the driver. The whole engine is supp[orte]d on powerful springs The foregoing is a description of an ordinary locomotive, but they vary a[illegible] for which they are required [illegible] weigh from 24 to 27 tons, and a heavy goods engine [o]ften weighs from 28 to 32 tons, with water and fuel In the larger locomotives there are six wheels, and some [illegible] [ab]le to convert 1,200 gallons of water into steam [illegible] hour, with a force equal to 400 or 500 horse-[power]. On the Great-Western line, the large loco[motiv]es are capable of exerting 1,000 horse-power. The [illegible] express trains travel at the rate of [illegible] [spe]ed is frequently equal to 65 miles [an] hour, or nearly 100 feet in a second. The most powerful goods engines are able to draw a load of 200 to 220 tons, amounting, with the weight of the waggons themselves, to 400 tons altogether. There are [illegible] [c]ountry, and of this number more than one [illegible] Their total cost is more than £10,000,000. Another class of locomotive engines are those for use on common roads, usually called *traction-engines*. Of these Boydell's is known as the "endless railway." Flat boards are disposed round the periphery of the wheels, furnished with rails of flat bar iron, which are thrown on the ground in succession by a self-acting arrangement, so that the wheels roll over a continuous series of rails laid on the ground. In Bray's traction-engine the wheels are made very large, with broad bearing-surfaces, and are furnished with claws at the periphery, which can be protruded when necessary to grasp the ground (*See* Steam-engine, Railway) The [illegible] illustration is the form [illegible] by Messrs Hawthorn, of Newcastle-upon-Tyne, in which all the recent improvements are embodied, including the patent auxiliary expansion-frame invented by this firm The engine is made, [acc]ording to the method generally adopted by Mess[rs]. H[illegible], with a cranked axle and outside bearings; it is furnished with six wheels (designated a six-wheeled engine), the driving and fore wheels, which are five feet in diameter and coupled together, and the hind wheels, three feet in diameter, are placed immediately below the fire box. By this arrangement the greatest safety is insured and particularly at high speeds, the same amount of stability being given to the engine as if the hind wheels were placed

behind the fire-box, with this additional advantage, that the length of coupling between the wheels may, by the present disposition, be regulated to any convenient distance. An engine of this description is constructed with the view of being used for general purposes, being adapted both for merchandise and for mixed or passenger trains at ordinary speeds; while for express or special trains, when a high rate of speed is required, railway travelling might be rendered comparatively safe by employing engines specially made and adapted for such a purpose. Fig 1 shows a longitudinal section of this engine, displaying the internal arrangements of the boiler and the working parts of the locomotive. Fig. 2 displays a general plan of the same. Attention and comparison of the following literal references with the drawing will afford an accurate idea of the details of this excellent engine. A is the external fire-box; B, the internal fire-box, C, C, stays for strengthening the roof of the internal fire-box, *a, a, a*, stays between the external and internal fire-boxes; *b* is the fire door, *c, c* are the fire-bars, *d* is the movable portion of the fire-bars; D is the ash-box; E, the cylindrical part of the boiler; *e, e, e*, the tubes; *f, f*, longitudinal stays from the back of the fire-box to the front of the boiler, F is the smoke-box; *g, g*, the smoke-box doors, G is the chimney; H is a brass funnel for inclo ; the safety-valves, *h*, the spring safety-valve; *i*, the lever safety-valve ... balance; *j*, the water-gauge and gauge-cocks, *k*, the steam-whistle; *l*, the blow-off cock; I, the steam-receiver; *m*, the inverted cone, for preventing priming, J, J, the steam-pipes; K, the regulator valve-chest, *n*, the regulator-valve; *o*, a rod connecting the regulator-valve with *p*, the handle for working it; *q*, the oil cup and pipe for lubricating the regulator valve, L is the steam-chest of the cylinders, *r, r*, th ... valves; M, M are the steam cylinders; *s, s*, the st ... ports; N, N, the discharge-ports and blast pipes, *t*, the blast regulator; *u, u* are handle-rods and levers for working the blast-regulator, *v, v* the damper with the handle, rods, and levers for working it, O O is the inside framing of the engine, P' is the steam-piston; a'', a'', the packing rings of the piston, b'', b'', wedges for tightening the packing. c'', c'', springs bearing in the back of the wedges b'', b'', d', the piston-cover; c'', c'', guards for the bolts of the piston-cover; P, P, the piston-rods; Q', Q', cross-heads for the piston-rods; *w, w*, the cross-head slides, x, x are projecting arms for working the feed-pumps; Q, Q, connecting-rods; R, the cranked axle; S, S, the feed-pumps; f', f', flanges for bolting the feed-pumps t the inside framing; g'', g'', the plunger of the feed-pumps; h'', lower, or suction-valve, of the feed-pump, i'', upper, or delivery-valve; j'', j'', stops for regulating the lift of the valves; *y, y*, the feed-pipes from the tender to the feed-pumps, *z, z*, branch pipes from the feed-pumps to the boiler, *a' a'*, valve-boxes at the boiler; *b', b'*, the pet-cocks with their handles; *c', c'*, the forward eccentrics; d', d', the backward eccentrics; *k', k'*, bolts for connecting the halves of each eccentric; *l, l*, steel pinching-screws, for fixing the eccentrics to the axle; *m'', m''*, the eccentric rods; *e', e'*, coupling-links for the ends of the eccentric rods, *f', f', f'*, levers, shafts, and rod for working the reversing-gear; *g', g'*, the main steam-valve spindles, *h', h'*, studs on the backward eccentrics for working the expansion slide-frames, , connecting-rods between the studs *h', h* and *i'*, the grooved arms for the variable expansion, *j', j'*, links bet the grooved arms and the levers *k', k', k', k', k'*, levers, shafts, and rods, for regulating the expansion-gear, *l', l'*, connecting-rods between the grooved arms *i', i'* and *m', m'*, the hollow spindles attached to *n', n'*, the expansion slide-frames, T, T the driving-wheels; *o', o'*, the outside cranks and coupling-rods; U, U, the fore wheels coupled to the driving-wheels, V, V, the hind wheels under the fire box; *p', p'*, springs for the inside bearings of the cranked axle *q', q'*, springs for the outside bearings of all the axles, *o'' o''*, connecting-hoop for the outside springs of the cranked axle, *r', r'*, the axle-boxes; *p'', p''*, pins for attaching the springs to the axle-boxes; *q'', q''*, cast-iron guides for the axle boxes; *r'', r''*, the spring links; '' '', the nuts for adjusting the weights upon the springs; W W, the external frame of the engine; X, X, stays from the external frame to the boiler; Y, the foot-plate; Z, the buffer-beam; *s', s'*, the buffers; *t', t'*, the safeguards; *u', u'*, a cock and pipe for letting off water from the cylinders; *v'*, the signal-lamp; *w', w'*, the hand-railing; *x'*, the pipe from the boiler for heating the water in the tender; *y'*, the drag-bar; *z, z*, the footsteps. The literal references to the tender, shown at figs. 3 and 4, are as follows:—A, the water-tank; B, the recess for containing the coke; *a a*, the floor of the coke-box; C, the opening to the tank, D, D, the tool-boxes; *b, b*, the cocks for regulating the supply of water to the feed-pumps; *c, c*, water- or suction-pipes to the engine; *d, d*, union joints for connecting the feed-pipes; E E, wooden frame of the tender; *e, e*, stays between the wooden and iron frames; F F, the iron frame for receiving the axle-boxes; *f, f, f*, the axle-boxes; *g, g, g*, the springs; G, G, G, the wheels, H, the vertical spindle and screw for working the brake; *h*, the hand-wheel for the brake-screw, I, the nut and link for connecting the screw with *i*, the brake-lever; J, the short shaft carrying the brake lever, and *j*, the double-toothed sector working into *k, k*, the longitudinal rods carrying the brake-blocks; *l, l*, supports fitted with rollers, for guiding the rods *k, k*; *m, m*, the wooden brake-blocks, *n*, socket for connecting the drag-springs to the drag-bars; *o, p*, the springs for buffing and drawing; *q, q*, bearings for the spring *o*; *r, r*, safety chains, *s, s*, footsteps; *t, t*, handles to assist in rising to the foot-plate; *u*, a hinged plate between the engine and tender; *v, v*, buffers for the tender, *w*, drag-chain of the tender. Fig. 3 exhibits a longitudinal elevation of the tender, showing the mode of its connection with the engine. Fig. 4 is the general plan of the tender, in which are seen the cocks for regulating the supply of water to the boiler, and the hand-wheel for working the brake apparatus. The following four figures are sectional views —Fig. 5, a longitudinal section of the engine, showing the internal arrangements of the boiler and the working ... of the engine, fig 6, a sectional ... engine, with the cylindrical part of the boiler removed for the purpose of exhibiting the general arrangement of the working parts and the construction of the fire-box, fig 7 is a longitudinal section of the tender; fig 8 is a general plan of the tender, with the tank removed, showing the framing, drag-springs, brake, gear, &c The following figures represent end elevations and transverse sections of the engine.—Fig 9, an elevation of the engine as seen at the fire-box end; fig. 10, a transverse section through the fire box; fig. 11, an e ... at the smoke-box end; fig 12, a ... the smoke-box. The following figures represent details drawn to a larger scale of such parts of the engine and tender as could not be fully shown in combination. Fig 13 is a transverse section of the steam-regulator and chest; fig 14, a longitudinal section of the same; fig 15 is a plan of the piston with the cover removed, to show the packing; fig 16 is a section of the piston through the lines 1, 2, 3, fig. 17, a plan of the same, complete, with the cover and guards, fig 18, a plan of the piston-rod, cross-head, with slide-blocks and projecting arm for working the feed-pump, fig. 19, a side view of the same; fig 20, an end view of the same, fig 21, an elevation of the backward eccentric, fig. 22, a plan of the same, showing the stud for working the expansion-gear, fig 23 is a side of the reversing or coupling link; fig 24 ... edge view of the same, showing the stud by which the valve is shifted into forward or back gear; fig 25, an elevation of the front end of the eccentric rod; fig. 26, a plan of the same, fig. 27, a longitudinal section of the feed-pump, with the plunger, valves, &c; fig 28, an end view of the same; fig. 29, a plan of the double safety-valve, with the seat; fig 30, a longitudinal section of the same; fig. 31, an edge view of the driving-wheel, half in section, to show the mode of fixing the arms, tyre, &c In this view is also given part of the cranked axle, to show the relative positions of the crank, wheel, bearing, &c.; fig. 32, a transverse section of the driving-wheel axle-box, and of part of the outer spring; fig 33, a longitudinal section of the same; fig. 34, a section of the suspension-link for adjusting the weight of the engine on the springs, fig. 35, a side elevation of the same; fig. 36, a general elevation of the tender brake-gear; fig. 37, a plan of the brake-

Locomotive Engine

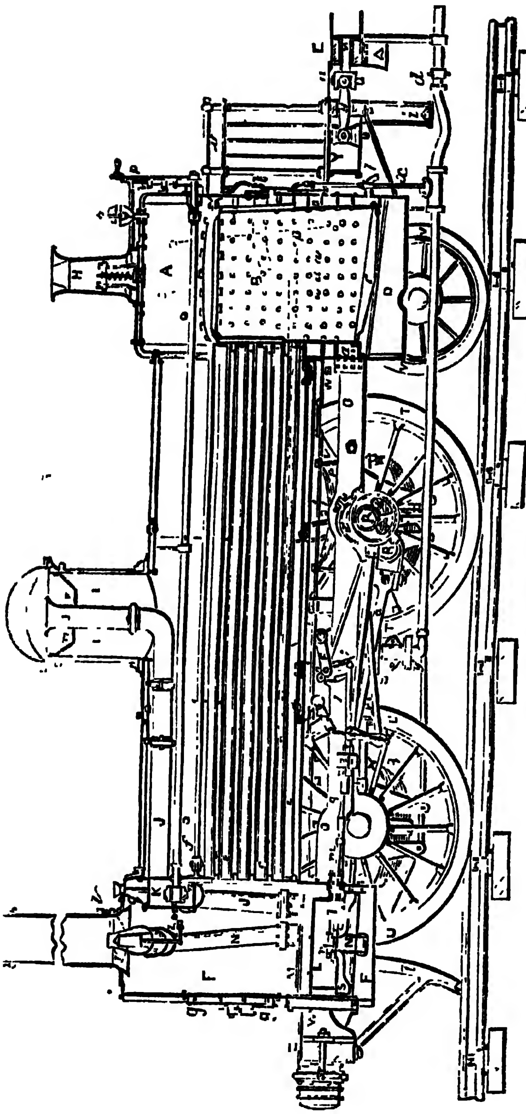


Locomotive Engine

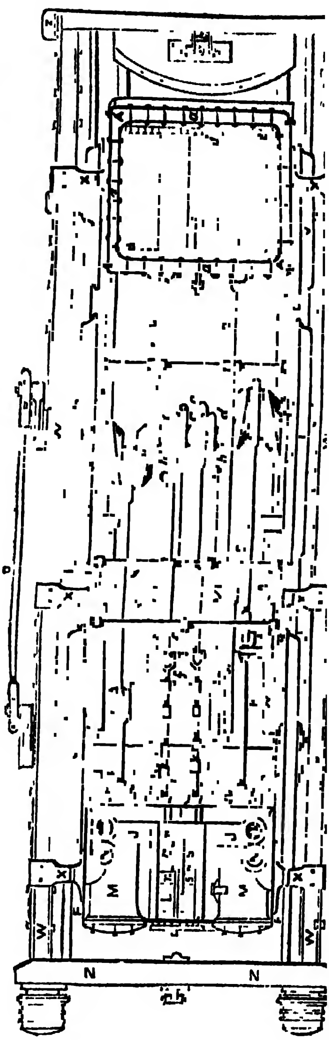


lever and toothed sector; fig. 38, the screw and link-nut for the tender-brake. We may now proceed to a detailed description of the engine. The first part of the engine which claims our attention is the fire-box. The form which Messrs. Hawthorn have adopted is clearly shown in the end elevation, fig. 9, and transverse section, fig. 10. It consists of two parts; the external fire-box A, which in reality forms part of the boiler, being filled with water to about fifteen inches from the top; and the internal fire-box B, placed within the other, and which contains the fuel for generating steam. The internal fire-box is made of copper, and tapered slightly towards the top, for the purpose of allowing the globules of steam which are formed on its sides to ascend more freely. To resist the downward pressure of the steam, the roof is strengthened by the strong malleable-iron stays C, C, balked across, and having a bearing against its sides, while both external and internal fire-boxes are secured against the lateral strain by having numerous iron stay-bolts (*a*, *a*, *a*) screwed through both boxes, and riveted at each end. The fire-door *b* affords access to the internal fire-box for the admission of coke. It is of an oval form, and the latch is provided with a chain for the greater convenience of opening and shutting. The space between the two fire-boxes at that part where the fire-door is situated, is furnished with a plate of iron riveted to the inside, at some little distance from it, to save it from warping by the intensity of the heat within. The fire-bars *c*, *c*, distinctly shown in the section fig. 5, and in the plan fig. 6, are ranged parallel to each other on a wrought-iron frame fixed to the under side of the fire-box, and a portion of them, marked *d* in the plan, is so arranged as to admit of their falling at one end, on the removal of the pin which supports them. In this case the burning fuel drops into the ash-box D, fixed below to receive it, and the combustion almost immediately ceases. The boiler next demands our attention. As before remarked, the external fire-box A forms part of the boiler, communicating freely with it, and being, like it, filled with water to the proper height when the engine is in operation. The boiler, properly so called, is marked E in the figures, and in the kind now under notice consists of a cylinder 11 feet 6 inches in length, and 3 feet 6½ inches in diameter outside. It is traversed throughout its length by 107 brass tubes *e*, *e*, *e*, 2⅛ inches outside diameter, of numbers 13 and 14 wire-gauge. These tubes are inserted into the front plate of the internal fire-box (called the "tube-plate"), which is made of sheet copper considerably thicker than the other plates of which the fire-box is composed, so as to afford a better bearing for the fixing of the tubes. At the front extremity of the boiler they pass through a similar plate of iron, which forms the partition between the boiler and the smoke-box. Into these plates are secured at both ends, by riveting, and subsequently by strong steel ferules accurately turned and driven firmly into the interior of the tubes, so as to render them perfectly tight and free from leakage. The cylindrical form of the boiler renders lateral staying unnecessary, and the tubes themselves at that part where they are situated, secure it against [illegible] three [illegible] the [illegible] able-iron stay-bolts (*f*, *f*, *f*) traverse the whole length of the boiler, and are secured to it by round pins passing through brackets riveted to the front tube-plate, and to the back of the external fire-box. The whole boiler is covered externally with a coating of thick felt and with strips of wood, called the "lagging" or "cleading," to prevent the radiation of heat, as well as to give greater symmetry of appearance. We now come to the smoke-box. The tubes *e*, *e*, *e* all open into that part of the boiler called the smoke-box (F), the purpose of which is to collect the gases evolved by the combustion of the fuel, and to transmit them through the chimney into the air. In this compartment of the boiler are also placed the steam-cylinders and other very important parts of the engine, to be hereafter described. The front plate of the smoke-box is furnished with large folding-doors (*g*, *g*) fitted air-tight to it, and provided with a handle, by which both doors are simultaneously shut and opened. These doors, which are shown in the end elevation, fig. 11, and in the section, fig. 5, serve to afford access for the insertion and cleaning of the tubes, as well as for the examination and repair of the parts of the engine referred to above. The safety-valves and boiler-mountings must now be described. Although the efficient working of the engine requires that the boiler be capable of generating steam of a high elastic force, yet it is essential to safety that the steam-pressure be confined within certain limits. In order to insure this, the boiler is provided with two safety-valves (*h* and *i*), both placed in one chest, fig. 29, fixed on the summit of the external fire-box, and surrounded by a polished brass chimney (H), of a form symmetrical with that of the large chimney G. One of these valves, marked *i*, which is of the kind called the "lever safety-valve," can be regulated to any required degree of pressure by the engine-driver, being furnished with a "spring-balance," by which the amount of pressure is distinctly indicated. The other safety-valve (*h*) is inaccessible, and is loaded by a spiral spring and screws, to such a pressure as may be considered safe, yet higher than the engine is expected, under ordinary circumstances, to require. To indicate the height at which the water stands in the boiler, as to enable the driver to keep it always at its proper level, a set of gauge-cocks and glass tube (*j*), communicating with the water inside, are fixed at a convenient situation near the foot-plate. A graduated scale is fixed behind the glass tube, and the required level may thus be maintained with considerable accuracy. As a precaution against accidents, and to give notice of the approach of the engine, a steam-whistle (*k*) is attached to the top of the fire-box, and communicates with the steam within by a short pipe provided with a stop-cock. The internal construction of the whistle is such that, when the stop-cock is opened, the steam rushing out with great force encounters the sharp edges of a species of inverted cup, thereby emitting a shrill and very loud noise, which can be heard at the distance of several miles. Behind, and at the lowest extremity of the fire-box, is situated the blow-off cock *l*, by which the boiler may be emptied of water when required, and for the purpose of cleansing it of the accumulation of sediment which is constantly being formed in it when the engine is in operation, it is provided with mud-holes both at the fire-box and smoke-box ends. These mud-holes, which are shown in figs. 9 and 12, are secured when the engine is at work by covers or doors bearing against the inside of the boiler, and fixed each by a single bolt passing through a strong wrought-iron bridge bearing against the outside. The steam-pipes and regulator-valve next need description. The steam-chest, or receiver (I), rises from the centre of the cylindrical part of the boiler, and is carried to a considerable height above it, in order that the mouth of the steam-pipe J, which opens into it, may be removed to as great a height as can conveniently be obtained, from the surface of the water in the boiler. The object of thus raising the open orifice of the steam-pipe is to prevent priming, that is, the ascent of water along with the steam, and its consequent flow through the steam-pipe into the cylinders, where its presence in any considerable quantity would produce the most serious inconveniences, besides the danger to which the boiler would be exposed by [illegible] pid abstraction. As a further precaution against priming, Messrs. Hawthorn make use of a simple but very ingenious contrivance. This consists of a species of inverted cone, *m*, fig. 5, made of sheet iron and riveted to the interior of the steam-chest, with an aperture in the centre, just wide enough to allow the free ascent of the steam between it and the steam-pipe which passes through it. The water in the boiler tends to prime chiefly where there is a surface of metal to which it may adhere; consequently, when in rising up the sides of the steam-chest, it encounters the inverted cone *m*, its course is diverted downwards and towards the centre, where, being unsupported, it falls back into the boiler. Should any priming occur round the sides of the steam-pipe itself, the water is in a somewhat analogous way diverted by the bell-shaped mouth of the pipe and returned into the boiler. The steam-receiver is surrounded by a polished brass dome, which, besides being ornamental to the engine, serves the very important purpose of diminishing the radiation of heat by interposing a stratum of heated air between the steam-chest and the external atmosphere.

Locomotive Engine



Locomotive Engine



The steam-pipe J is made of copper, and that part of it which is inclosed within the boiler is 5¾ inches internal diameter. It enters an orifice accurately bored and fitted to receive it, in the cast-iron regulator valve-chest K, which is bolted steam-tight to the exterior of the front tube-plate of the boiler. The valve-chest K incloses a regulator-valve (x) of a new and improved form, which, as well as the chest itself, is shown on an enlarged scale in figs 13 and 14. It is formed of cast iron, and has two projecting faces accurately and smoothly turned, and of such form and dimensions as, when placed in the position shown in fig. 13, completely to cover the orifices of the two branch steam-pipes J, J, whose faces are bored truly cylindrical and of the same diameter as that of the faces of the valve. The distance between the contiguous edges of the two branch-pipes is somewhat greater than the breadth of the valve-face, so that, when turned round in either direction, the orifices of both pipes may be fully ope ied. In the centre of rotation of the valve is an ' ing hole, into which fitted the correspondingly formed end of a long rod (o o) traversing the whole length of the boiler, and passing steam-tight through a stuffing-box in the back-plate of the fire-box. A long lever-ha dle (p) is fixed to the outer extremity of this rod, : d the engine-driver is thereby enabled, with the greatest ease and precision, to regulate the supply of steam to the cylinders. A small pipe (q) screwed into the upper part of the valve-chest, rises through the smoke-box, and is surmounted by a cup and provided with cock, by which oil may be admitted into the i of the valve-chest for the lubrication of the orking parts. The two branch steam-pipes J, J, as will l. seen by reference to the section, fig. 12, open a communication for the admission of steam from the regulator valve-chest K into the valve-casing or steam-chest L L. They are each 3¾ inches internal diameter and they, as well as the discharge pipes N, N, are so disposed within the smoke-box as not to obstruct the cleaning or replacing of the tubes The cylinders and valve are now to be described. The slide-valves, with their expansion slide-frames, are placed between the cylinders M, M in one steam-chest (L), formed by the construction of the cylinders when bolted together, as will be seen by inspection of fig. 6. By this arrangement access is afforded to both valves by the removal of only one cover, which seems to be an improvement over the other methods. The steam-cylinders M, M are 14 inches in diameter, with .. stroke of 21 inches. They are placed at a slight angle in the smoke-box for the purpose of being accommodated to the position of the cranked axle The form and dimensions of the pistons P″, P″, and the arrangement of the packing-rings a'', a'', are indicated in figs. 15, 16, and 17. The packing consists of two cast-iron rings (a'', a'') turned slightly eccentric, the thick sides in each being set diametrically opposite At these points they are cut, and wedges (b'', b'') fitted accurately into the openings. These wedges are pressed outwards by two springs (c'', c''), which are adjustable by set screws. The whole is rendered compact and secure by the piston-cover d'', which is bolted to the body of the piston by four bolts, guarded by the pieces e'', e'', as shown in fig. 17. Th m-po s, s, which communicate between each unts t the cylinders and the slide-valves r, r, a the body of the cylinders, as are also the discharge-ports N, N to the point where the blast-pipes are jointed to them. The discharge, or blast-pipes, N, N, ascend from each cylinder till they reach the botto of the chimney, where they are ed into e pipe, in the orifice of which is placed or tap plug (l), so disposed and connec ed by means of system of rods and levers (n, n), as to be capable being raised or depressed by the engine driver. this means the orifice of the blast-pipe m y be enlar or contracted at pleasure, thereby cau ing a gre or less draught to the fire By this contrivance engine-driver is enabled to adapt the quantity of s generated in the boiler to the exact amount req for the supply of the engine, and thereby prevent the waste of fuel, indicated by the steam blown the safety-valve. For the further regulation of the draught when the engine is at rest, it is provided with a damper (v) at the lower end of the chimney, worked, like the blast-regulator, by a system of rods and levers, also marked r, v, and terminating near the foot-plate. The framing and connections of the engine next demand our attention. Having described the internal arrangements of the engine, we now proceed to explain the parts by which motion is communicated to the wheels. These are fully delineated in combination in the sectional elevation, fig. 5, and in the plan, fig. 6. Between the smoke-box and internal fire-box are bolted the four strong malleable iron beams O, O, O, called the inside framing, and which, besides imparting great strength and rigidity to the whole structure, serve the purpose of giving fixed points of resistance for the bearings of the working parts. Of these the first that claim our attention are the piston-rods P, P. These are made of steel turned truly cylindrical and smooth, and of the diameter of 2¼ inches. They are fixed in the piston with a cotter, in the manner indicated in the detail, figs 15 and 16; and at the opposite extremity they are terminated each by a cross-head (Q′), also attached to them by a cotter, fig. 18. On these cross-heads are bearings for the small ends of the connecting-rods Q Q, and concentric; and of the same piece with these bearings are projecting arms, into which the cast-iron guide-blocks w, w, figs 18 and 19, are fitted The guide-blocks are formed with flanges, and are accurately fitted and ground into steel slide-bars, also marked w, u, so as to work smoothly and steadily between them These latter are set truly parallel, and in the same inclined plane with the centre of the p ods d ly bolted to the framing-plates O, O. By th ns the piston-rods are constrained to move in a rectilinear direction, and secured gainst any deflection, or undue strain, arising from the continual change of position of the opposite ends of the connecting-rods, in obedience to the revolution of the cranks to which they are respectively attached. The feed-pumps S, S, for the supply of water to the ler, are also set on the line of the piston-rods, and their plungers partake of their motion, being each fixed to a small arm (a), firmly secured by a cotter to the cross-head Q. The pumps, the internal arrangement of which is shown in the longitudinal section, fig 27, are formed of cast iron, and are firmly fastened to the inside framing O by bolts passing through the projecting flanges f'', f''. The plungers g'' are of brass, 2 inches diameter, and at each stroke of the engine draw the water from the tender through the . .d pipe y and lower or suction-valve h'', forcing it at the return stroke through the upper or delivery-valve i'', and along the pipe z, into the boiler The valve are prevented from rising out of their seats by the stops l'', l'', fixed into the covers of their respective chests, and so adjusted as to admit of their rising only to the proper height for the due ingress and egress of the water At the point where the water is discharged into the boiler is placed a valve-box, a', within which is a valve, opening upwards, for the retention of the water within the boiler. A small cock, called the pet cock (b'), is fitted to the outside of the feed-pump, and by means of a long slender rod the handle is brought within reach of the engine driver, so that he may be enabled to ascertain at any time whether the pump is working efficiently. The connecting-rods Q, Q are jointed, as we have already explained, to the cross-heads of the piston-rods. T effected in the usual way by means of cotters, properly secured against relaxing or falling out. The opposite ends are attached in the same to the cranks R, R, upon the axle of the driving-wheels This nked axle is made of the t forged iron, the cranks being cut out of the solid mass, and the one formed exactly at right angles to the other In the earlier stages of locomotive-engine building, it was usual to provide bearings for the cranked axle upon each of the frames O, O; but this practice is now discontinued, and thereby the machinery is much simplified, and the friction considerably reduced The eccentrics and valve gear come next in th order of description. This engine is provided with four eccentrics,—two for the forward and two for the backward gear The form and dimensions of these are shown upon an enlarged scale in fig. 21, which gives a view of the backward eccentrics, bu

Locomotive Engine **Locomotive Engine**

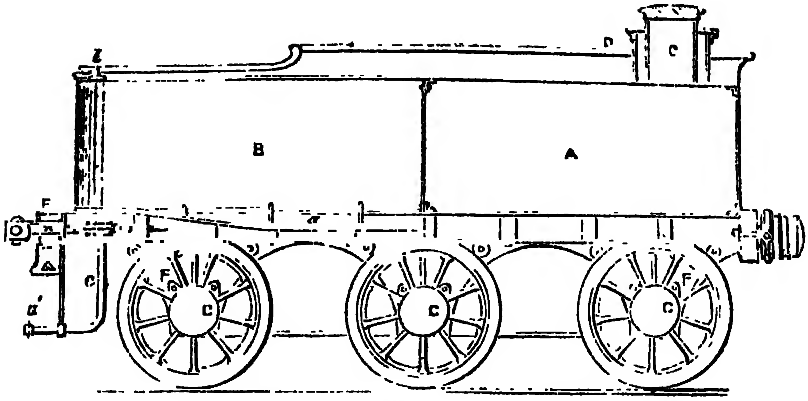


Fig. 7.

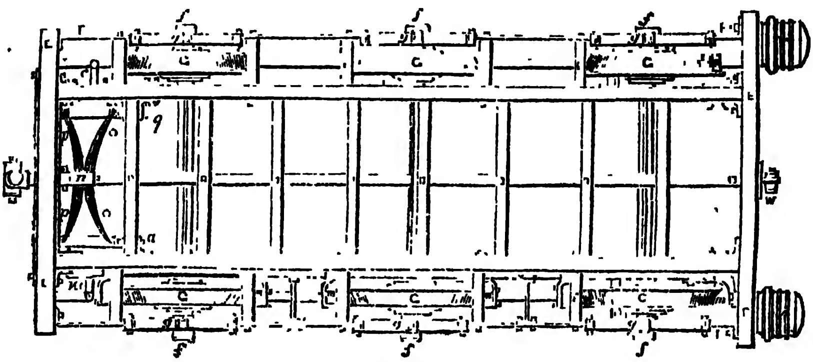


Fig. 8.

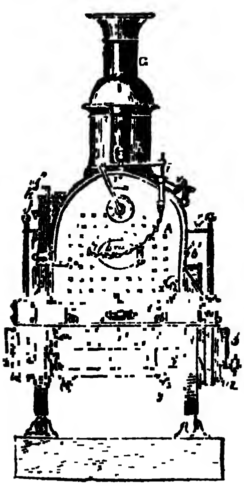


Fig. 9.

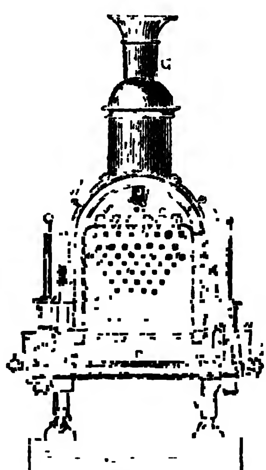


Fig 10.

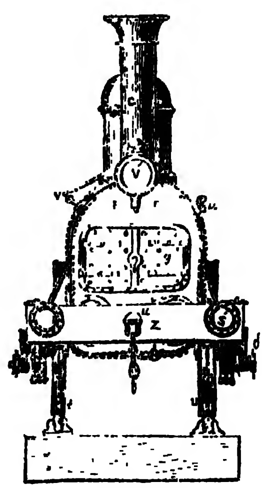


Fig. 11.

which, with a slight difference, presents an accurate type of the whole set. Each eccentric is formed in halves, for the purpose of embracing the axle, and these are joined immovably together by the two round pins k'', k'', screwed into one half, and secured after passing through the other by cotters. It is fixed firmly to the axle by the two pointed set screws l'', l''. The forward eccentrics for both cylinders are fixed upon the axle a little in advance of a line at right angles to their respective cranks, for the purpose of giving the required lead; and the position of the backward eccentrics is adjusted upon the same principle, though of course in a diametrically opposite direction. The eccentric rods m'', m'' are bolted firmly to the brass strap surrounding the eccentrics, and their opposite extremities, the form of which is shown in fig. 25, are connected together by a double link (e', figs. 23 and 24), so formed as to admit of either forward or backward eccentric being thrown into gear with the valve-spindle, as may be required. The link which Messrs. Hawthorn employ for coupling the ends of their eccentric rods is of a new and improved construction, being so formed as to diminish as much as possible the friction and wear upon the slide-rod pin and the eccentric-rod ends. The reversing-gear, or mechanism by which the engine-driver is enabled to propel the engine in either direction, consists in a system of rods and levers (f', f', f'), commencing with a stud upon the lower extremity of the coupling-link e' and terminating in a long handle placed in a convenient position near the foot-plate. The motion of the eccentrics is communicated directly to the slide-valves by means of valve-spindles working through oblong guides at the one extremity, to insure steadiness, and attached at their opposite ends to t[illegible] slide-valves by nuts and jam-nuts, for the purpose [illegible] adjustment. The description of the auxiliary slide-frame and gearing may next be given. On each of the backward eccentrics is fixed a stud (h', fig. 21), to which is jointed a rod, the other extremity of which is connected with the upper arm of a double lever working upon a bearing fixed to one of the framing-beams O, O. The lower arm of this lever is grooved throughout its length to receive a sliding-pin, attached by a link to a system of rods and levers, terminating in a long handle, working on the same centre with the reversing handle. The sliding-pin is also connected by the rod to the hollow spindle, which works through the stuffing-box of the valve-chest L, and incloses the spindle g of the ordinary slide-valve. The expansion slide-frame is worked by the hollow spindle being attached to it by means of a slender malleable iron frame, embracing it on all sides, and screwed to the end of the hollow spindle. It is fitted to, and works upon, the same face as the ordinary slide-valve; but is of such form as, when the frame is in motion, to overlap alternately the ends of the latter (the back of the slide-valve being accurately planed and fitted for that purpose), according to the amount of expansion required. This can be varied at pleasure by the mechanism already described; for when the sliding-pin which works in the grooved arm is brought into the centre of motion of that lever, it is obvious that no motion of the slide-frame will ensue, and in this position, when it is not required to work expansively, the gearing may be secured so as to obviate all unnecessary wear and tear. If, however, the handle be advanced into the position represented in the general elevation, fig. 1, the [illegible] and rod (i') which is attached to it will [illegible] downwards, as shown in fig. 5, and the slide-frame will partake of the motion communicated to the lever i' by the backward eccentric, and the amount of this travel will obviously be in proportion to the distance at which the sliding-pin is set from the centre of motion. A graduated sector is placed at the foot-plate in view of the engine-driver, as shown in the general elevation, for the purpose of indicating minutely the amount of expansion, or at what part of the stroke the steam is cut off. The wheels and outside frame come ne[x]t in the order of description. The driving-wheels T, T are firmly fixed to the cranked axle, the ends of which, produced beyond the bearings, carry the cranks and coupling-rods o', o'. The other extremities of these rods are connected by cranks of exactly the same dimensions with the axle of the fore wheels U, U. By thus connecting the driving and fore wheel, the amount of *traction*, or the surface upon the rails available for the propulsion of the engine, is greatly increased, which renders this species of engine peculiarly suitable for drawing luggage or other heavy trains at moderate speeds. The hind, or trailing-wheels, V, V, are situated under the fire-box, and the advantages of this arrangement have been already pointed out. The dimensions of all these have also been already given, and the mode of their construction will be clearly understood by reference to fig 31, which shows both external and sectional views of one of the driving-wheels, but which, as far as regards construction, may be taken as a type of the whole. The nave is of cast iron, moulded and poured round the arms, which have been previously prepared by a dovetail at their inner ends, for the purpose of giving additional security. The arms and rim are of the best forged iron, and the latter is accurately turned in the lathe, after being welded together. The tyre, which is also of the best forged scrap-iron, is bored internally to a slightly smaller diameter than the rim, and shrunk on. It is then secured to the rim by a few rivets, and the whole turned accurately to the proper form and diameter. As the whole weight of the engine rests upon the [w]heels, it may be expected to suffer from jolting in passing over the irregularities of the rails. To obviate this as far as possible, the springs p', p', p' and q', q', q' are interposed, the former upon bearings in the outermost of the internal framings O, O, and the latter [illegible] r the axle-boxes r', r', r' of the main external bearings. The springs marked q', q', and the mode in which they are attached to the axle-boxes and to the f[illegible] are represented in figs. 34 and 35. They are [illegible] of thin layers of steel, gradually diminishing in length from the centre to the extremities, and bound together by the connecting-hoop o'', secured in its place by a small round pin, passing through it and the steel plates. The connecting-hoop is formed with a tail projecting upwards into the lower portion of the axle-box, where it is fixed by a round pin (p'') passing through it. The axle-box r', which is of cast iron fitted with bearings composed of metallic alloy favourable for the reduction of friction, slides up and down as the springs bend with the weight of the engine, between the cast-iron axle-guides q'', q'', which are accurately planed and fitted to receive it, and bolted firmly to the plates of the external framing. The axle-boxes are formed with a sort of reservoir for oil or tallow, which is constantly supplied to the rubbing surfaces by two small tubes and siphon-wicks. It may be here remarked that the other rubbing surfaces of the engine are lubricated in the same manner. The mechanism by which the springs are attached to the external framing is shown in figs. 34 and 35. These parts are called the *spring-links*, and consist of a species of small cross-head (r'') fitted with round pins, for passing through the plates of the external framing, and with screwed studs attached by similar round pins to the ends of the springs q', q'. The nut s'' works into these screws, and by means of it the weight which it may be thought expedient to throw upon each spring may be accurately adjusted. The external f[illegible] of two strong parallel beams (W, W) [illegible] beyond the engine at both ends, and connected in front by the wooden cross-beam or *buffer bar Z*, and behind by a similar beam, on which rests the foot-plate Y. The beams are firmly bound together at the corners by angular plates of iron bolted through each, and the weight of the boiler is supported upon them by the strong malleable iron brackets or stays X, X, X, riveted to the boiler, and bolted through the beams W, W. These latter are formed each of two parallel plates of iron, cut into the form shown in the general elevation, with horns projecting downwards for the bearings of the wheels. Between each pair of plates a beam of well-seasoned oak is interposed, and the whole is firmly bolted together. To deaden the shocks to which the engine is exposed, it is provided with buffers (s', s'), fixed to, and projecting in front of, the buffer-bar Z. To secure the engine against the effects of the wheels coming in contact with stones or other obstacles which may happen to be lying on the rails, it is furnished with

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strong malleable iron safe guards (t', t'), descending from the external framing to within a short distance of each rail, and so formed at the points as to turn aside any object with which they may come into collision. Any water which may happen to accumulate in the cylinders, whether from the priming of the boiler or the condensation of the steam, and which, unless removed from time to time, would be very detrimental to the working of the engine, is let off by means of the pipe and stop-cock n', communicating with the discharge-passage of each cylinder When the engine is at rest, the steam which would otherwise escape at the safety-valve and be thrown to waste, is made available for the heating of the water in the tender This is accomplished by means of the bent pipe v', by which a communication is made between the steam within the fire-box and the feed-pipe v, and

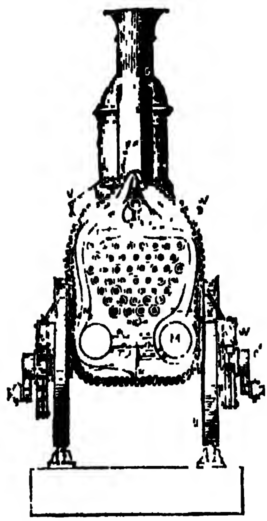

Fig 12

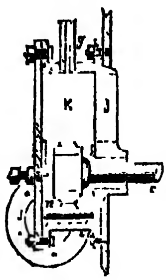

Fig. 14.

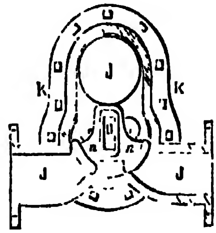

Fig. 13.

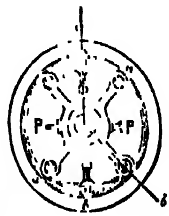

Fig. 15

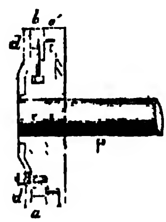

Fig 16

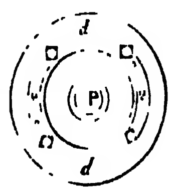

Fig 17.

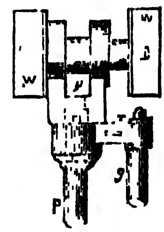

Fig 18

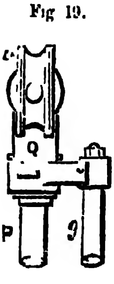

Fig 19.

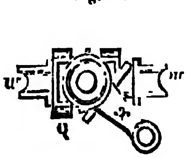

Fig. 20.

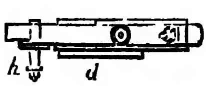

Fig 22.

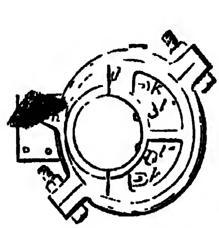

Fig 21.

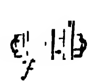

Fig 24

Fig 23.

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there is considerable room for the display of tasteful design and judicious arrangement, we have thought that we should render our engravings more interesting and more acceptable by giving representations of both. The water-tank A A forms the principal part of the tender, and consists of a rectangular sheet-iron cistern capable of containing 1,200 gallons of water for the supply of the boiler It is made with a long recess (B), for the reception of the fuel The floor (c) of this recess is made with a slope downwards from the front of the tender, by which arrangement the fuel is prevented from being thrown out by any jolting or shaking to which it may be subjected. Towards the back of the tank it is surmounted by a pipe or opening (C), by which water is introduced from the water-crane or other contrivance for that purpose A wooden cover is fitted over this opening ... point are fixed the

ting of a considerable amount of vibration or change of position of the pipes without breaking the connection. The tank is secured to a strong wooden frame (H R), forming the body of the tender, and strengthened by numerous cross-beams. The tender is supported upon six wheels (G, G, G), of the same diameter as the trailing or hind wheels of the engine, and is constructed in the manner described in treating of the latter. The brake apparatus, which is shown on an enlarged scale in fig 30, consists of a train of mechanism by which a great amount of friction can be simultaneously produced upon the peripheries of the tender-wheels for the purpose of reducing the mo-

latter will be drawn upwards, and, carrying with it the lever *i*, the toothed sector *j* will be made to revolve upon its axis J, and, consequently, the rods *k*, *k* will be drawn each in the opposite direction to the other. Each wheel will, therefore, be forcibly compressed between the brake-blocks *m*, *m*, and the engine and train be proportionally retarded. At the point where the engine is connected with the tender, the latter is provided with a system of springs to deaden the effects of shocks from either direction This consists of two springs set back to back, and connected together by a socket (*n*) which receives the end of the drag-bar The fore-spring *p* comes into action when any force is

Fig. 27.

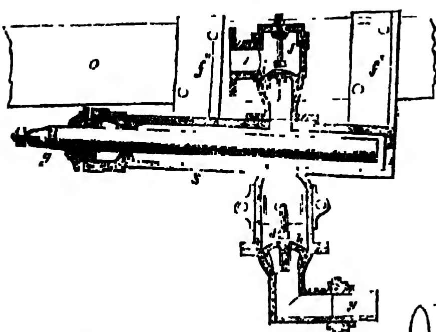


Fig. 31.

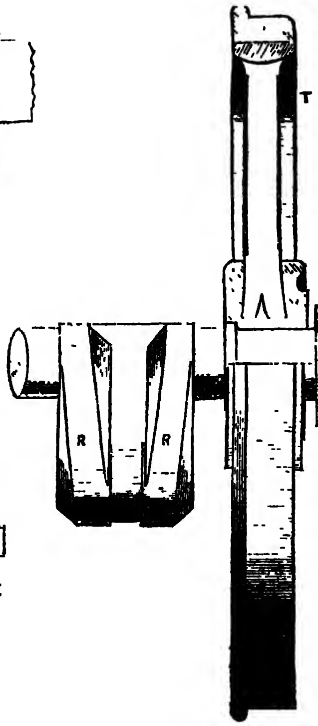


Fig. 33

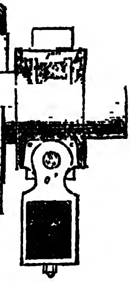


Fig. 28.

Fig. 25

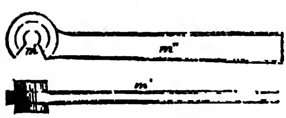


Fig 26

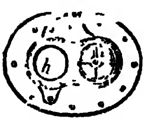
mentum of the engine and train, when it is required to arrest the motion of the train The hand-wheel *h* is fixed to the upper extremity of the vertical spindle H, working in a strong bearing attached to the tank The lower part of the spindle is formed into a screw, and works through the wrought-iron nut I, on which is forged a double link, jointed at its lower end to the brake-lever *i*. This latter has its centre of motion in the short shaft J, which works in strong bearings attached to the wooden frame, and carries the double-toothed sector *j*. Two longitudinal iron rods (*k*, *k*) extend the whole length of the tender, and a small portion of each towards the front extremity is formed into a rack, so adjusted as to work into the teeth of the sector *j*. The rods *k*, *k* are supported and guided in their motion by small rollers working in the wrought-iron guides *l*, *l*, *l*, and upon them are bolted the wooden brake-blocks *m*, *m*, *m*, by the contact of which with the exterior surface of the wheels the friction is produced By this arrangement it is obvious that, by screwing the vertical spindle H into the nut I, the

applied tending to separate the engine from the tender, as in starting a train, and the hinder spring *o*, when the force is applied in the opposite direction. Both springs are supported upon pieces of thin iron bolted between the beams of the frame, and the extremities of the spring *o* bear upon the two guide-pins *q*, *q* For further security, in case of the ordinary connections failing, the safety-chains *r*, *r* are attached between the engine and tender. For the accommodation of the engine-man and stoker the tender is furnished with footsteps (*s*, *s*) placed at an easy distance above the steps of the engine. By these arrangements and with the assistance of the handles *t*, *t*, the foot-plate is rendered easily accessible. At the front of the tender a piece of boiler-plate (*u*) is fixed by hinges, for the purpose of forming a floor where the engine and tender are connected. At the other extremity of the tender the buffers *v*, *v*, similar in construction and in situation to those formerly described, are fixed to the cross-beam of the tender-framing, for the purpose of deadening the shocks produced by

Locomotive Engine

the occasional irregularities of motion between the engine and the train. The drag-chain *s*, which is firmly secured to the same beam, forms the connecting-link between the tender and the train. In the annexed illustration, fig. 39, we give a view of the celebrated "Rocket" with its tender, invented by George Stephenson. We have described this locomotive at the commencement of this article. Fig. 40 shows the "Sanspareil," by Timothy Hackworth. The weight of this engine was 4 tons 15 cwt. 2 qrs., the tender, water, and fuel being 3 tons 6 cwt. 3 qrs. The third engine tried with the "Rocket" and the "Sanspareil," and called the "Novelty," was invented by Messrs Braithwaite & Ericsson. It is given at fig. 41. It weighed 3 tons 1 cwt. These engines were all tried in

Fig. 29.



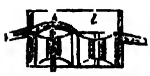


Fig. 30.

Fig. 32.

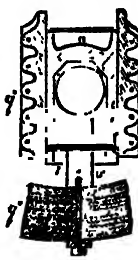


Fig. 33.

Fig. 34.

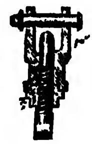


Fig. 37.

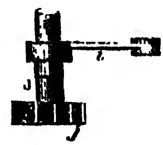


Fig. 38.

fessors and other scientific gentlemen of Edinburgh a working model of a steam-carriage. This gave such proofs of practicability, that he was urged to carry the machine into practice. Such, however, were the difficulties to be overcome in this, that he conscientiously stated his scruples to those anxious to aid him in the matter, advising them not to proceed with it. In fig. 42 we give a lateral view of the steam-carriage model, as constructed by Symington. *d*, the cylinder, *e*, the boiler supplied from the condenser; *f*, *f*, direction-pulleys, *g*, condenser, *h*, steam-pipe, *i*, water-tank; *a*, drum fixed on the hind axle, *b*, tooth and ratchet-wheels, *c*, rack-rods, one on each side of the drum. The alternate action of each upon the teeth and ratchet-wheels produces the rotatory motion.

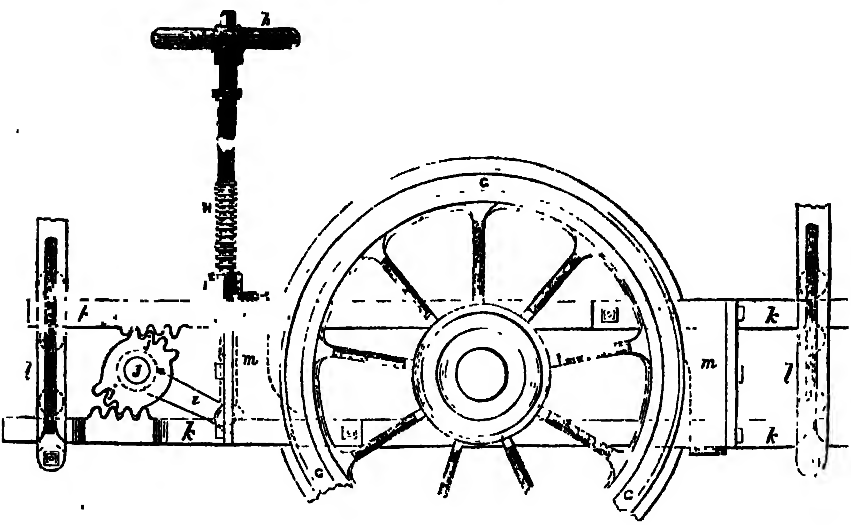


Fig. 36

competition just previous to the opening of the Liverpool and Manchester Railway, in 1830. The "Rocket" was the successful engine. Another claimant for the honour of having introduced the first steam-carriage is the celebrated William Symington, the engineer now acknowledged by [illegible] the first introducer of a [illegible] As early as 1784 it occurred to him that steam might be applied to the propulsion of carriages. He commenced experiments with a view to perfect the idea, and in 1786 submitted to the inspection of the pro-

The "Novelty" possessed some arrangements of considerable merit, the most distinguished feature being the construction of the boiler and the fire-place. This will be seen by an inspection of the diagram fig. 41: *d* is the fireplace placed inside the boiler and surrounded with water; fuel is supplied to the fireplace *c* by the tube or funnel *e*, passing through the dome of the boiler, and covered with a lid or cap. Air is forced into the fire, to maintain combustion, by a small pair of fanners, worked by the engine, through the pipe *b*, communicating with the ash-pit *c*. The

heated air is forced along the series of pipes *f g* to the chimney *h*, the steam space being *i i*. By this arrangement, a large amount of heated surface is obtained; the fireplace not only being surrounded with water, but also the long range of pipes *f g*. The peculiar arrangements of the engine will be seen by the diagram, fig 41. It is a most difficult if not impossible thing to say who really was the first to suggest the use of the steam-engine for the purpose of propelling carriages One authority claims the honour for Watt. In the patent taken out by that distinguished inventor in 1784, he described the application of the steam-engine to the moving of wheeled carriages. The boiler of the machine he proposed was to have a *wooden boiler*, fastened with iron hoops like a cask. An iron was to be placed within the boiler, so as to be surrounded on all sides by water. The boiler was to be placed on a carriage, the wheels of which were to receive their motion from a piston working in a cylinder; the reciprocating motion being converted into a rotatory one by toothed wheels revolving with a sun-and-planet motion, and producing the required velocity by a common series of wheels and pinions. By means of two systems of wheel-work, differing in their proportion, he proposed to adapt the power of the machine to the varied resistance it might have to overcome from the state of the road Watt, however, never built a steam-carriage Another writer, however, states that Watt did at least construct a model, of which we give a diagram at fig 41. At fig. 45 we give a longitudinal section of a "fast passenger-engine" constructed by Mr Hackworth. It has been especially designed for fast passenger-trains, having driving-wheels 6 feet 6 inches in diameter, with leading and hind wheels of 4 feet diameter. Its weight in working order is 23 tons 15 cwt, and this is distributed in the following manner. on leading wheels 8 tons 6 cwt, drivers 11 tons 4 cwt, and hind wheels 4 tons 5 cwt The fire-box is at *c c*, the smoke-tubes at *d d*, the balanced spring safety-valves at *a* -- *b*, the steam-whistle, *s s*, the smoke-box; *k*, the blast-pipe; *m*, the chimney, *c c*, the regulator; *c*, the regulator-handle; *n*, the pipe supplying steam to one cylinder; *o*, the feed-pipe, to supply water to boiler from the tank in tender. In fig. 46 we give the elevation of an American locomotive, with outside cylinders; and in fig 47 a longitudinal section of the same. *c c*, the fire-box, *d*, *d*, the flue-tubes; *s s*, the smoke-box; *e e*, the conical blast-pipe, the opening of which is regulated by the levers as in the drawing; *m m*, the steam-dome; *n n*, the steam pipe; *r r*, the regulator-dome; *o*, the regulator, consisting of a spindle-valve actuated on by the lever *o'*, admitting steam to the cylinder through the pipe *o'' o''*, *l l*, the steam space above the tubes; *p p*, the lock up spring safety-valves; *f g*, the funnel; *i i*, *h h*, *k k*, the "spark-arrester." The curved arrows show the direction of the heated air; the sparks being deposited in the curved vessels *i*, *i*, the heated air and steam passing out at the vertical apertures *k*, *k* The eccentric rods and gear for working the valves, &c., are shown at *b b*.

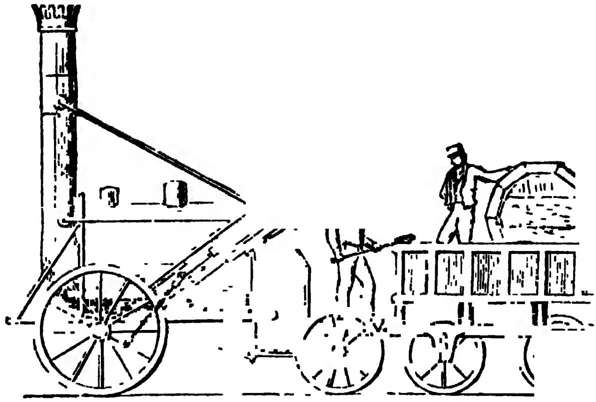


Fig. 39.—The Rocket.

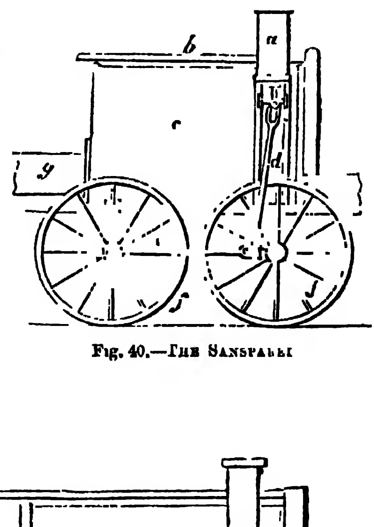


Fig. 40.—The Sanspareil

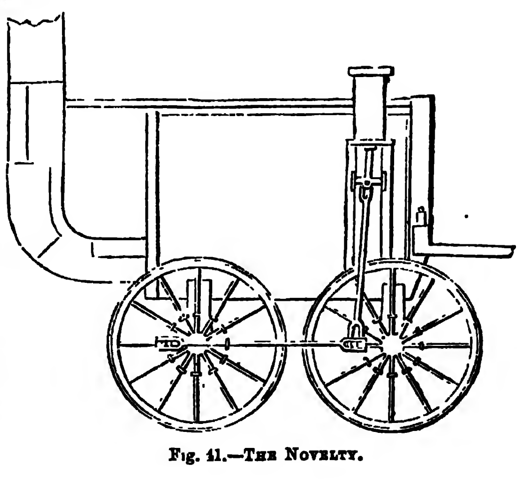


Fig. 41.—The Novelty.

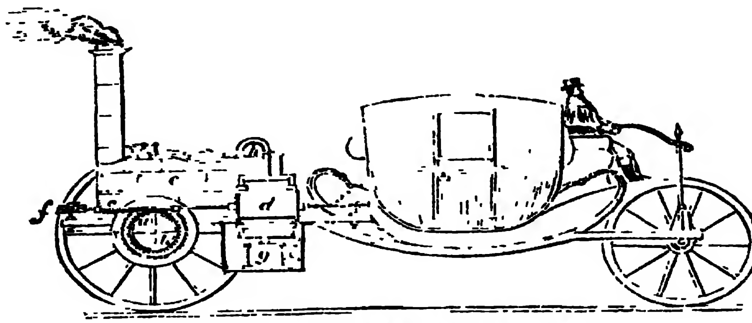


Fig. 42.—Simington's Steam-Carriage.

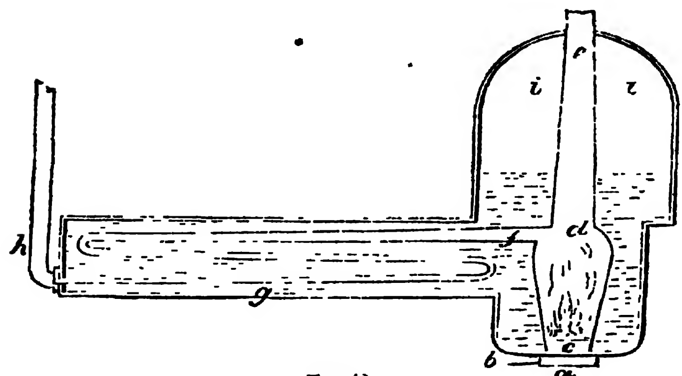


Fig. 13.

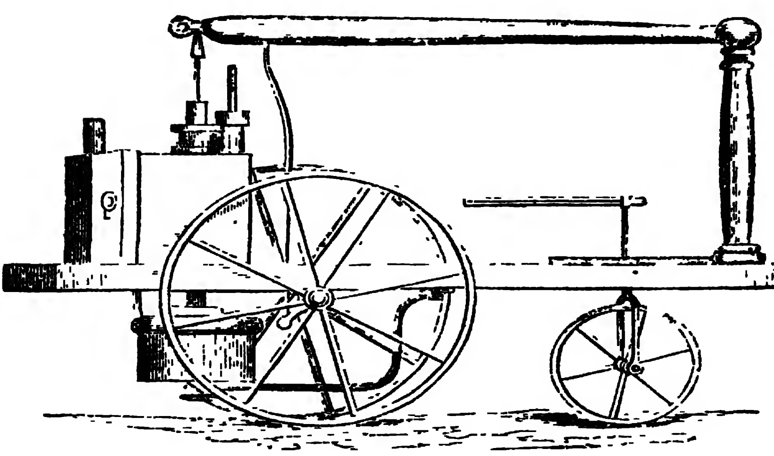


Fig. 14.

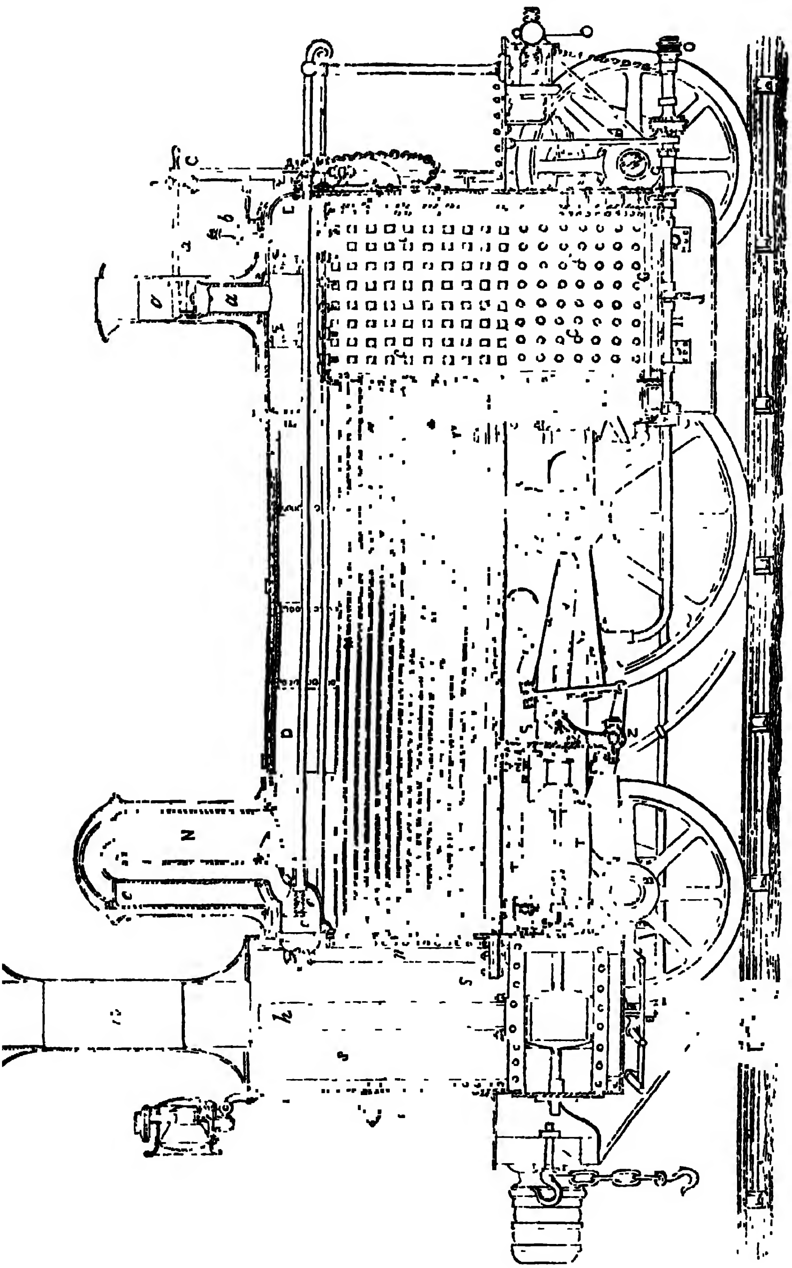


Fig. 45.—Longitudinal Section of Fast Passenger Engine.

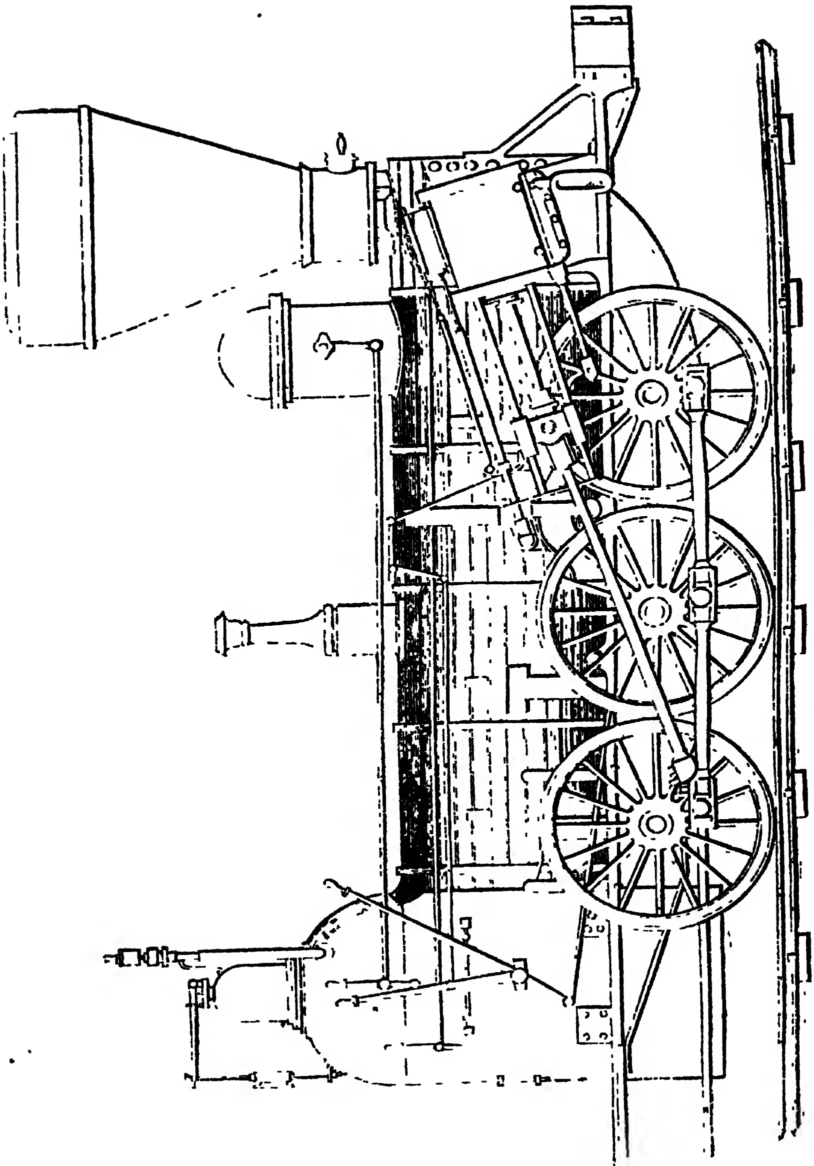


Fig. 46.—American Locomotive. Elevation.

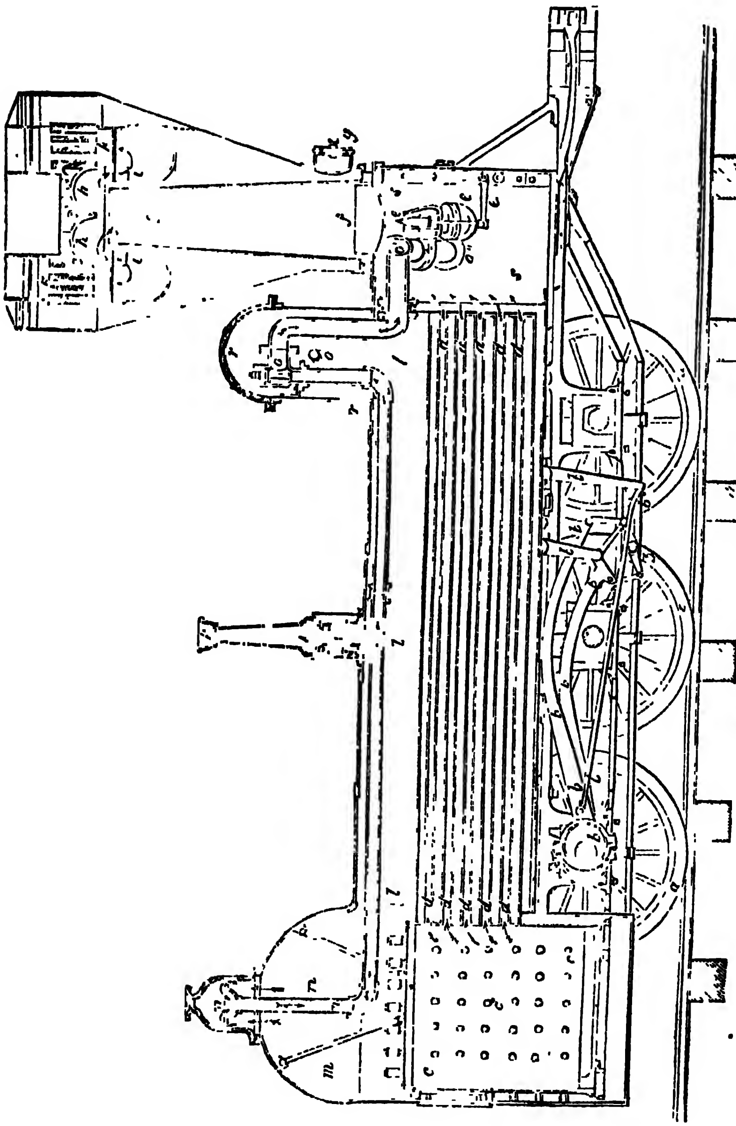


Fig 47.—American Locomotive. Section.

LOCUSTS, LOCUSTIDÆ, *lo'-kusts* (Lat. *locusta*, a locust), a fam. of insects belonging to the ord. *Orthoptera*, and containing several genera and many species. Locusts are spread all over the globe, and generally appear in great numbers. The species found in Europe are rather small, but some of the exotic varieties are large. Their food consists of leguminous plants. During spring and the beginning of summer they are in their larva state, but in the latter part of the summer they become perfect insects. Locusts, like many other insects belonging to the order *Orthoptera*, have the faculty of producing a harsh, creaking noise, by acting upon their elytra, or wing-covers, with their hind legs. On account of the veins being considerably elevated in the elytra, and the inner edge of their thighs being rugose with spines, the rubbing of the one against the other produces the noise. Of all the species, the migratory locust (*Locusta migratoria*), although a small insect, is one of the most destructive to man. Its powers of destruction are , and as they are produced in great numl de · · · ln After consuming all within their reach, they take flight in swarms to some adjoining district. At times the number of locusts is so great that the sky is absolu · · ps id re they alight assume the appearance of a barren waste, almost in an instant. These insects appear periodically in several parts of central Europe, in Egypt, Syria, and almost all the south of Asia, and spread terror and dismay before them. Rewards are offered for the collection of both the eggs and the perfect insects in the south of Europe. It is on record that in 1613, at Marseilles, 20,000 francs were paid for this purpose. A similar plan is adopted in Turkey and in China. A large species of locust, beautifully coloured, *Locusta cristata*, is common in Southern Afr id inhabitants of some countries make use of the larg species of locusts as food. They pull off their wings and fry them in butter or oil, or pickle them.

LODE, *lode*, in Min., a Cornish term for a running vein of metal, or even stone, of any particular kind. When the lode is valuable, it is called a *live lode*, and when worthless, a *dead lode*.

LODGE, *loj* (Fr. *loge*), a term applied in Arch. to a small house situated in a park or domain, subordinate to the mansion, also the cottage situated at the gate of the avenue which leads to the mansion. In this last sense it is nearly synonymous with the term "gatehouse."

LOG and LOGLINE, *log, log'-line* (Ang.-Sax.), nautical terms expressive of the means used to ascertain t rate of a ship's speed. The *log* is a piece of wood the form of the sector of a circle (usually a quadrant) of five or six inches radius. The following description is taken from Brande's Dictionary. It is about a quarter of an inch thick, and so balanced by means of a piece of lead nailed to the circular part, as t perpendicularly in the water, with about two-thirds immersed under the surface. The logline is a small cord, one end of which is fastened to the log, and the other wound round a reel in the gallery of the ship. The log thus poised keeps its place in the water, while the line is unwound from the reel as the ship moves through the water; and the length of line unwound in a certain time gives the rate of the ship's sailing. Th term or phrase generally employed with reference t employing the log is termed "heaving the log." Knots along the line allow the calculation of the speed to be made; and the time is generally checked by a sand-glass running a certain number of seconds,—generally 30 or 45, some to 60 seconds, indeed. The length between the knots is so proportioned to the time of the glass, as the number of knots unwound is to the number of miles the ship is sailing per hour. The first knot is placed about five fathoms from the log, in order to enable the latter to get clear of the ship before the reckoning commences, and the part of the line between the lead and the first knot is called the *stray line*. A patent form of log, by which the calculation is made by a species of clockwork, whose motive power is water, is now, however, generally adopted, particularly in steam-vessels.

LOGANIACEÆ, *lo-găn-e-a'-se-e*, in Bot., the *Spigelia* or *Strychnos* fam., a nat. ord. of *Dicotyledones*, subclass *Corolliflora*; consisting of tropical shrubs, herbs, and trees, with the following characters:—Leaves opposite and entire, with stipules, the latter occasionally existing only in the form of a raised line or ridge; calyx 4–5-parted, corolla regular, 4–5 or 10-cleft; æstivation valvate or convolute; stamens sometimes anisomerous, anthers 2-celled, pollen 3-lobed, ovary 2, 3, or 4 celled, style simple or l w, and with as many divisions above as there are cells to the ovary, stigma simple. Fruit capsular or drupaceous, placentas axile, ultimately detached. Seeds usually peltate, sometimes winged, with fleshy or cartilaginous albumen. The *Loganiaceæ* are almost universally poisonous, acting on the nervous system, and producing frightful convulsions. There are 25 genera and about 200 species. (*See* IGNATIA, SPIGELIA, STRYCHNOS.)

LOGARITHMIC CURVE, *log-ă-rith'-mik*, a curve in the higher branches of analytical geometry, which possesses the property of having its *abscissæ* proportional to the · · · of the corresponding *ordinates*.—*Ref.* · · *of Curves.* (*See* CONIC SECTIONS and GEOMETRY.)

LOGARITHMS, *log'-a-rithms* (Gr. *logos*, proportion, and *arithmos*, number).—The *logarithms* of numbers may be briefly · d to be the · of other numbers, which render the powers of the latter, denoted by the exponents, equal to the former series. In most elementary mathematical works, the definition of the word is thus given:—The logarithm of a number y is such a value of the index x, of a *fixed* magnitude a, as will satisfy the equation y · a^x; that is, x is *defined* to be the logarithm of y in a *System of Logarithms*, whose *Base* is a; and the logarithm of y will therefore depend entirely upon the quantity a, · be assumed to be any finite magnitude whatever, *unity* only excepted, on account of every arithmetical power or root of 1 being only 1, which thus prevents that number from obeying the conditions stated above. In order, therefore, to constitute a logarithm, it is necessary that the exponent should fe · of · ical proportion, corresponding to as many others in geometrical proportion. If we take, for example, the series of 10, we have 10^1 = 10; 10^2 = 100, 10^3 = 1,000, and 10^4 = 10,000; we thus attain the results that the logarithm of 10 = 1, the logarithm of 100 = 2, of 1,000 = 3; and of 10,000 = 4. This can be · ed, lo · lo rithm · ithmetical term for a number, by which the · · of a certain fundamental ratio is expressed · · to a fixed fundamental ratio. Thus, in the two runs of arithmetical and geometrical proportion, the numbers thus proceed:—

Ar. Pro.	0,	1,	2,	3,	4,	5,	6,	&c.
Geo. Pro.	1,	2,	4,	8,	16,	32,	64,	&c.

Consequently, if we add 1 and 3 together in the first line, 4 corresponds to 16 (standing under it), which is identical with the multiple of 2 and 8, which stand under the 1 and 3. The upper line in arithmetical proportion forms the logarithms of the lower, in geometrical proportion, and logarithmic tables furnish these intermediate fractions, corresponding with the intermediate numbers in the lower line. A table of logarithms, made according to an assumed basis or fundamental ratio of all numbers to a certain limit, is called a · · · system. Logarithms were first invented · · · · , Baron of Merchiston, in Scotland, · · · · known by him in a work published in 1614, under the title, "De Mirifici Logarithmorum Canonis Constructione." This system was varied by Henry Briggs (a cotemporary of Lord Napier), who constructed another system having for its base the number 10, which, · · · our system of numeration, has many advantages over that constructed by Napier, being much more convenient for ordinary purposes of calculation. Briggs calculated his on the fundamental basis of the ratio 10 to 1; consequently, the logarithm of 10 is 1; of 100, 2; of 1,000, 3; and so on. It is, therefore, evident that all logarithms of numbers between 10 and 1 must be more than 0, but less than 1; in other words, must be fractions,—thus, the logarithm of 6 is 0·7781513. Again, all logarithms of numbers between 10 and 100 must be greater than , but less than 2; or, that is to say, must be whole

numbers *plus* a fraction; for instance, the logarithm of 95 is 1·9777236. The properties and advantages of logarithms are very great by their utility in facilitating the arithmetical operations of multiplication and division, which, when large numbers are concerned, usually take up much time. If the multiplication of two large numbers has to be effected, it is only necessary to take from the logarithmic tables the logarithms of the numbers in question, add these together, and the result will be the logarithm of the required product. In division, logarithms of the numbers have merely to be deducted from each other, and the result will be the logarithm of the dividend. If numbers have to be raised to powers, then logarithms are multiplied; if roots are to be extracted, the logarithms are [illegible] to be divided by the exponent of the root. The integral part of a logarithm is called its *characteristic*, because it shows at once of how many digits the natural number corresponding to the logarithm to which it is prefixed is composed. If, therefore, we know the logarithm of any number, we need only add 1, 2, 3, &c., to its characteristic, in order to obtain the logarithm of a number 10 times, 100 times, or 1000 times as great. For instance,—

log 73591	=	4·8668124
log 7359·1	=	3·8668124
log 73·591	=	1·8668124
log 7·3591	=	0·8668124
log. ·73591	=	$\bar{1}$·8668124

In the [illegible] example, the negative sign is only placed over the characteristic, as that alone is negative; but the general mode of procedure with regard to these minor logarithms is to give them their arithmetical complements, substituting the real value in the final result. In the Naperian system, the *modulus*, or basis, of the tables is 1; and consequently the Naperian logarithm is easily found from the common [illegible] (those of Briggs), by multiplying the [illegible] of the latter by l_{10}. The Naperian logarithms are often called *natural logarithms*, on account of the modulus of their system being unity; while the common logarithms of Briggs are called *tabular logarithms*, in contra-distinction to the former. The method which was first employed to compile logarithmic tables was founded on the successive extraction of roots, and consequently calculations arose of vast difficulty and tedium; in the present day, however, the method is far more simple, and the computations are thus rendered much more expeditiously. Suppose, for instance, it be required to find the logarithm of any number x, by means of converging series. In the first place it must be assumed that $\log.(1+x)=Ax+Bx^2+Cx^3+Dx^4+$ &c (1), in which A, B, C, D, &c, are coefficients, like determinates. (*See* INDETERMINATE COEFFICIENTS.) Therefore, taking another number, z, we have, in a similar manner, $\log.(1+z)=Az+Bz^2+Cz^3+Dz^4$ &c. (2); then subtracting the second equation (2) from the first (1), we shall have the result—

$$\log.(1+x)-\log.(1+z)=A(x-z)+B(x^2-z^2)+C(x^3-z^3)+\&c \quad (3)$$

But from the properties possessed by logarithms we know that $\log.(1+x)-\log.(1+z)=\log.\frac{1+x}{1+z}=\log.\left(1+\frac{x-z}{1+z}\right)$; and on our bringing out the equation by the same means as $\log.(1+x)$ was treated in the first equation, we obtain the result that $\log.\left(1+\frac{x-z}{1+z}\right)=A\frac{x-z}{1+z}+B\left(\frac{x-z}{1+z}\right)^2+$ &c. Substituting, therefore, this development for $\log(1+x)-\log(1+z)$ in the third equation (3), and dividing both by $(x-z)$, there results,—

$$A\frac{1}{1+z}+B\frac{x-z}{(1+z)^2}+C\frac{(x-z)^2}{(1+z)^3}+\&c$$
$$=A+B(x+z)+C(x^2+xz+z^2)+\&c.$$

Now, as this equation is true independently of any particular values of x and z, let us suppose that $x=z$, and it becomes—

$$A\frac{1}{1+z}=A+2Bz+3Cz^2+4Dz^3+\&c.$$

which, on expanding the quantity $\frac{A}{1+z}$ by division, gives $A(1-z+z^2-z^3+z^4-\&c.)=A+2Bz+3Cz^2+4Dz^3+\&c.$ Therefore, by the theory of indeterminate coefficients, we must have the separate equations $A=A$, $-A=2B$, $+A=3C$, $-A=4D$, &c.; and on substituting the resulting values of B, C, D, &c., in terms of A in equation (1), we get—

$$\log.(1+x)=A\left(\frac{x}{1}-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\frac{x^5}{5}-\&c.\right)$$

The quantity A, which is still indeterminate, being the [illegible]dulus, and assigning to it any particular value, we [illegible] at once characterize the system which we wish to consider. It would be impossible in the present [illegible]icle to enter at length upon the different theorems for the compilation of logarithmic tables, and nearly as useless, as the tables at present in existence are [illegible] sufficient for all practical purposes. The history [illegible] of logarithms will be found in Hutton's "Mathematical Tracts," which enter upon the subject at length. The best tables extant are those of Babbage, which are most carefully collated and compiled. For navigation and astronomy, Farley's "Tables of Six-figure [illegible]" are the best. The use and application [illegible] in trigonometry will be found under TRIGONOMETRY.—*Ref.* Brande's *Dictionary of Science, Literature, and Art.*

LOGIC, *lod'-jik* (Gr. *logike*), considered in its most catholic relations, is the science of formal and material reasoning. In its strictly formal aspect, logic is the science of the necessary laws of thought; in its material aspect, again, it is the science of the laws of thought applied to practice. In the former sense it is a Science, in the latter it is an Art. In the one sense, then [illegible] complete, perfect; in the other, it is [illegible], imperfect. The formula for material logic is *some is all*, the formula for pure logic is *all is all*. The latter, or *deduction*, is always explicative of [illegible]; the former, or *induction*, [illegible] the contents of a thought. As it is usual to consider those two phases of human reasoning apart, in the following brief outline, pure logic, or Deduction, will first be treated of, and next applied logic, or Induction.

I. *Pure Logic, or Deduction*.—It is necessary to observe that no progress in logic can be made without the preliminary assumption of the facts of psychology. In other words, the existence of sense, perception, memory, association, and so forth, lies at the basis of every process of reasoning. Pure logic is an *à priori* science, not an *à posteriori* one, for it deals exclusively with those truths on which all experience depends, rather than those truths which form the substance of experience itself. This system of doctrine owes its existence to Aristotle, who not only indicated its outline, he virtually created the science. In the progress of its history it has received various minor modifications and additions from various philosophers; but until Sir Wm. Hamilton's time no logician made material improvements on it from the days of the Stagirite himself. It is usual to divide formal logic into three parts.—1. *Concepts or notions*; 2. *Judgments*; 3. *Reasonings*. In other words, the formation of general notions, the decision whether those concepts agree or not, and the drawing of one such judgment from another. These parts in their order, and first of *Concepts*. This, by the way, is the most important part of logic, and one on whose laws the entire science may be regarded as in a great measure depending. What, then, is a concept? It is the result of an act, known as conception, which includes the comprehension of the various qualities of an object up to unity. Notions, again, are rather the apprehension of these qualities than the final bundling up of them, which belongs exclusively to conception. The two terms, however, are frequently used synonymously. When the mind, after surveying a series of objects, draws away (*abstrahère*) or abstracts a number of qualities from those objects, and classifies them, arranges them into orders or genera, generalizes them in short, and gives a name to each class so formed, the process of conceiving or forming concepts may be said to have been gone through. It is obvious that a considerable variety will take place in the character of the concepts

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so formed, some will be more general, some will be less general, though all will be reducible to genera and species. Thus, the individual, or single objects, as *this horse, that man*, being the names of so many facts or things on which logic is supposed to operate, belong neither to genus nor species, and are properly beyond its domain altogether. The lowest species (*infima species*) can never be a genus. The highest genus (*summum genus*) can never be a species. The subaltern genera (*genus subalternum*) are genera to those beneath them, and species to those above them. Thus, *Socrates* is an infi[illegible] spec[illegible] *being* is a summum genus, and *man* is a s[illegible] [illegible] to Socrates and being. [illegible] regard the *Quantity* of [illegible] concept, we recognize th[illegible] classes of th[illegible] [illegible] t may be predicated, or the characters of which it is made up. In the former case, we regard the Extensive Quantity of concepts, in the latter, their Intensive Quantity. Thus, in the expression *man*, or *rational animal*, if I abstract the *rational* from *animal*, I thereby diminish the intensive or internal quantity of the concept, but increase its extension. For the ter[illegible] [illegible] eh [illegible] number of objects than *man*. The leading words that are employed in designating the quantity of concepts are, for their extension, *class* or genus; for their intension, *mark*, note, attribute, character. We amplify the extension of concepts by abstraction or generali[illegible] amplify their intension or compre[illegible]on by determination. We resolve the exte[illegible] of a notion by division; we resolve its intension by definition. Hence an individual notion cannot be divided (*in-dividuum*), and a simple, or definite notion (*de-finitum*) cannot be defined. Again, as the characters of a concept may be more or less firmly seized by consciousness, more or less perfectly grasped, we have the [illegible] cal *Quality* of concepts, or their relative clearness or distinctness, and their obscurity or indistinct[illegible]. The peculiar form which a concept assumes when recalled by the mind, brings us abreast of the most important controversy in all speculation,—that of Nominalism and Realism. Leibnitz's answer to this question is the one now adopted by all intelligent logicians. It is that, when [illegible] [illegible] under the notion, or we only comprehend a few of those marks at the time, though we assume we know them. In the former case it is *intuitive* or notative knowledge we have of the notion, in the latter case it is *symbolical*. In the third place, concepts may be mutually compared as to their *Relation*, which consists in the reciprocal comparison of their various attributes. That is to say, that notions can only be compared as to their mutual extension, and as to their mutual comprehension one with another. So much for the doctrine of Concepts. We proceed now to the second part of logic; namely, *Judgments*. A judgment is the affirmation that two concepts can or cannot be reconciled, or (more correctly, that two concepts, a concept and a thing, or two individual things) agree or disagree. As we have just recognized a certain quantity, quality, and relation among Concepts, so we must now recognize a quantity, quality, and relation as affecting Judgments. This is why it was remarked some time ago, that the thorough comprehension of the doctrine of Concepts may be regarded as the thorough comprehension of the master principle of logic. In the judgment, *Socrates is rational*; *Socrates* is called the subject, *rational* the predicate, and *is* the copula. But in numerous propositions the copula is not expressed, it is merely understood. The [illegible] judgments is taken from their quantity, or their relation of subject and predicate, as reciprocally [illegible] and part. Is the predicate viewed as the cont[illegible] whole? The judgment is pronounced an extensive one. Is the subject regarded as the containing whole? The judgment is an intensive or comprehensive one. Thus, in the proposition, *All plants grow*, if we view *grow* as the containing whole, we have a proposition in extension, as *All plants belong to the class of growing objects*. And if, in the same proposition, we view *plants* as the containing whole, we have a proposition in Comprehension, as *The attribute or mark of growing belongs to all plants*. But judgments have a certain quality as well as quantity, according as the [illegible] and predicate reciprocally agree or disagree, affirm or deny, in the quantities of extension and intension. In reference to their quantity and quality together, propositions are usually designated by the vowels A, E, I, O. The Universal Affirmative are denoted by A, the Universal Negative by E, the Particular Affirmative by I, and the Particular Negative by O. Or, to employ the mnemonic lines of Petrus Hispanus

Asserit A, negat E, sed universaliter ambæ;
Asserit I, negat O, sed particulariter ambæ.

But these four species of proposition are obtained solely by [illegible] *quantity of the subject alone*, together w[illegible] [illegible] of both subject and predicate. Now this is where the importance of Sir William Hamilton's "thorough-going quantification of the predicate" comes in. He proposes *not only to quantify the subject, but the predicate also*. Eight species of propositi[illegible] thus evolved, which taking A and I for universal and particular as in the Aristotelic notation, but extending them to either quality, and marking affirmation by an *f*, and negation by an *n*, we have the following sets of pr[illegible]:

Affirmatives.

1. Toto-total—AfA All X is all Y.
2. Toto-partial AfI All X is some Y. (A)
3. Parti-total—IfA Some X is all Y.
4. Parti-partial—IfI Some X is some Y. (I)

Negatives.

5. Toto-total AnA—Any X is not any Y. (E)
6. Toto-partial AnI Any X is not some Y.
7. Parti-total—InA—Some X is not any Y. (O)
8. Parti-partial InI—Some X is not some Y.

Of all these judgments 6 and 8 are the weakest, yet it is always possible to allege that *any man is not some brute*, or that *some man is not some brute*. Yet it must be acknowledged that [illegible] these propositions are conceivable, they a[illegible] practical utility. The [illegible] great division of judgments is their relation, or the coincidence or non-coincidence of subject and predicate. This relation is either simple or conditional. On the former alternative the proposition is *Categorical*, on the latter—inasmuch as the condition lies either in the subject alone or in the predicate alone, or in both the subject and predicate—it is *Hypothetical*, *Disjunctive*, or *Dilemmatic*. So there are four kinds of relation between the subject and predicate of a proposition, which may be exemplified as follows. *A is B* is the formula for a categorical judgment; *If B is, A is*, is a hypothetical one, *D is either B or C or A* is a disjunctive one, and *if X is A, it is either B or C*, is a dilemmatic one. We may remark in conclusion on this part of our subject, that the Aristotelic doctrine of the categories and of the predicables, as properly extra logical, of course finds no place here. The third grand division of logic is *Reasoning*, or Syllogism, or the process by which one judgment is derived from another or more. And as in Concepts and in Judgments we have here recurring again the old relations of quantity, quality, relation. It must not be forgotten that the essence of syllogism consists in the production of a new and distinct judgment, not in the *truth* of any one of the given judgments. The *Premises* are the two given propositions or the antecedent, and the *Conclusion* is the proposition sought, or the consequent. The premise which announces the general rule is called the *Major*, the one which announces the application of the general rule is called the *Minor*, and the *Middle term* is that with which the two extremes of the conclusion are separately compared. The three propositions of a [illegible] [illegible] [illegible] [illegible]ectly expressed by the [illegible] [illegible] *Conclusion*. [illegible] are two kinds of inference,—immediate and mediate. When we can decide at once, as soon as we understand the terms of the two propositions involved, whether they agree or disagree, the inference is termed *immediate*, but when we require to go in quest of a third or *middle* judgment or term with which each of the other judgments may be compared, the inference is called *mediate*. For example,—All good rulers are just, therefore no unjust rulers can be good, is a specimen of immediate inference, and,—All consumptions are [illegible]ortal, this disease is a consumption; therefore this disease is mortal, is an example of mediate reasoning.

The different sorts of immediate inference can be pursued no farther here. There is a general canon for conducting Mediate reasoning, which may be thus expressed. The agreement or disagreement of one judgment with another is ascertained by a third judgment, inasmuch as this, wholly or by the same part, agrees with both or with only one of the conceptions to be compared. There are a number of general rules for the proper construction of syllogisms, which may be conveniently condensed as follows. Distribute the middle term (*i e.* take it in its widest signification), let there be no fourth, and both premises must be neither particular nor negative. The conclusion then will follow the worst part (as "some flowers are blue"), and will neither distribute nor deny unless when the premises do so. All Mediate inference is properly one, —that often called by logicians the categorical, for the conditional and hypothetical syllogisms are all reducible by immediate inference The regular syllogism, then, regarded as to its essential form, comes now to be considered And first of the *figure*, or the position of the middle term in the premises, and of the *mode* or mood, or the formal value of the three judgments of a syllogism as to their quantity, quality, and relation. There is only one figure according to some logicians, three according to others, and four according to a third party. These are as follows, where S represents the subject, P the predicate of the conclusion, and M the middle term. Fig I.—MP, SM, ∴ SP. Fig II —PM, SM, ∴ SP. Fig. III —MP, MS, ∴ SP. Fig IV.—PM, MS, ∴ SP. The Terms alone being here stated, the quantity and quality, indeed the Mood of the whole of the syllogisms, remain to be filled up; in other words, between M and P, for example, we may place either a negative or affirmative copula, and we may prefix either a universal or a particular sign to P The Moods are ordinarily expressed in each figure by the three letters which severally denote the quantity and quality of each judgment. Thus, AII, Fig. I., reads as follows, which can be readily verified by turning back to the mnemonic lines which were given under Judgments. All M is P, some S is M; therefore some S is P. And EIO, Fig II, reads,—no P is any M; some S is some M, therefore some S is no P. IAI, Fig. III., reads,—some M is some P; all M is some S; therefore some S is some P; and so on. A few mnemonic lines of considerable convenience have been invented which serve to point out the various moods in each of the four figures, according to the old notation. They are as follows:—Fig. I.—bArbArA, cElArEnt, dArII, fErIOque prioris. Fig. II.—cEsArE, cAmEstrEs, fEstInO, bArOkO secundæ Fig. III —tertia, dArAptI, dIsAmIs, dAtIsI, fElAptOn, bOkArdO, fErIsO, habet; quarta insuper addit. Fig IV. — brAmAntIp, cAmEnEs, dImArIs, fEsApO, frEsIsOn. There will be found nineteen legitimate modes in the whole of these figures, but sixty-two according to Sir William Hamilton's extended notation (for which see above to his extended judgments). Before leaving this part of the subject, it may be well to state that the first figure is the most perfect, that is to say, it exemplifies best the Aristotelic dictum *de omni et nullo*, or whatever is affirmed or denied of class may be affirmed or denied of any part of that class. To take an example. All plants need light; sunflowers are plants, therefore sunflowers need light. Some logicians, as Aristotle, Kant, and Sir William Hamilton, throw overboard all the figures but the first, and with them of course annihilate reduction. Reduction is the process by which the other figures are brought under the form of the first figure. This is usually effected by changing the order of the terms, or where that cannot be done, by substituting a privative conception (as "unwise" for example) for a positive judgment, and then changing the order of the terms by conversion as it is called. As often occurs, many a piece of reasoning, being without subjects or predicates expressed, belongs properly to no figure. There have been, in all, three peculiar schemes of syllogistic notation,—those of Lambert, Euler, and Sir William Hamilton. The last is by far the simplest and most complete, but cannot be exhibited here A conditional or hypothetical syllogism contains, of course, a conditional or hypothetical judgment, and a disjunctive syllogism contains a disjunctive judgment. These have all been disposed of as belonging properly to immediate inference. When syllogisms are taken in their external form, we have three species of reasoning which require some elucidation. There is first the Epicheirema, or reason-rendering syllogism; there is, secondly, the Sorites, or chain-argument, as the Germans call it; and there is, thirdly, the Enthymeme, with one premise suppressed. To illustrate,—the Epicheirema is B is A; but C is B, for it is D; therefore C is also A. The Sorites is, A is B, B is C, C is D, D is E; therefore A is E; reduced to B is C, A is B, therefore A is C; C is D, A is C, therefore A is D; D is E, A is D, therefore A is E. The Enthymeme, as a kind of colloquial argument, needs but little illustration here. All these species of reasoning have various forms. Besides these, there are the Monosyllogism, where the reasoning is viewed as an independent whole; the Prosyllogism, whose conclusion is a premise in a given syllogism; and the Episyllogism, whose premise is a conclusion in a given syllogism. These arguments very frequently occur in life. It should not be forgotten, however, that the simple syllogism is the type of all reasoning. So much for formal logic.

II *Material Logic, or Induction* (the *epagoge* of Aristotle), signifies properly the drawing of a general law from a sufficient number of particular cases. It is distinguished from pure logic by caring wholly for the *matter*, or facts, or truth of its objects, while the former is occupied entirely with the correctness of the *form* of thought. And here, at the outset, it is necessary to take a distinction, which may be of great use afterwards. There is what is called a *perfect* induction and an *imperfect* one. The perfect one is when the investigator has been able to examine *all* the particular instances on which this law is founded; the imperfect induction, again, forms ninety-nine one-hundredths of all inductive reasoning, and mounts at once from the few cases in which the law holds to the *all*. Perfect induction was denominated by Bacon *res puerilis*, as it on very few occasions can *add* anything to what one is already in possession of. Indeed, it is often taken up under the formal syllogism The latter, again, *imperfect* induction, is the peculiar kind of all ordinary scientific induction. And the great canon or principle, which is itself a principle of induction, on which this form of material science rests, is the constancy and uniformity of nature's laws Or, more articulately expressed, it runs thus,—*under the same circumstances, and with the same substances, the same effects always result from the same causes*. Material, or applied logic, to fulfil its aim, must have attained,—1. to as true statements as possible respecting the objects with which it deals; 2. it must be able to define those objects with as much clearness and precision as possible; 3 it must be able to indicate the extent of those objects, and, 4. it must exhibit its results in a systematic manner. These preliminary obligations being imposed upon it, it requires, in the second place, to be able to answer the following four leading questions —1. How are the causes of phenomena to be distinguished among a multitude of other phenomena all open to observation? 2. How are causes to be discovered which are less open to observation than the effects produced by them? 3. When should an incomplete enumeration of facts be deemed sufficient, and on what principle? 4. How should new laws be expressed and recorded? These questions, in their order.—1. How the causes of phenomena are to be distinguished. It must be here observed, respecting causation, what the scholastic writers never forgot, that it is properly all the associated causes—the concauses, as it is sometimes phrased, that make up what is ordinarily denominated "the cause" of a thing. And every event has more than one cause when strictly analyzed. Yet men, nevertheless, inquire for "the cause" of a phenomenon; and justly enough, for what they want is the most influential agent in the production of the result. It requires no labour beyond "simple enumeration," to enable one to discover such very uniform and regular laws as the recurrence of the tides, and the law that all weighty bodies fall. But it requires a great degree of patient observation and research to discover that the one phenomenon is connected with the moon's influence, and that the other depends on the higher law of gravitation. All men

open to the observation of these phenomena had a rude notion of the tides and of falling bodies, but it required a Newton to complete the theory of both the phenomena. The chief rules which regulate the inquiry after causes are the following:—1. While the same effect may sometimes arise from different causes, yet the cause must always be sought among the invariable concomitants of the effect. 2. If an effect is not produced under certain circumstances, this either indicates the absence of the cause, or the presence of a counteracting one. 3. The cause is often suggested by analogy. 4. The cause is often indicated by the variation of degree of the effect. 5. The more forms of the effect that are studied, the greater is the probability of finding out the cause. 6. A suspected cause may be tested by allowing it to operate under less-complicated circumstances. 7. Where complications exist, every cause should be noted and registered down to the minutest detail. So much for the answer to the first question.—2. Causes are sometimes discovered which are not obvious, even after careful observation and detailed experiment, by what is called Anticipation. Such was Oken's discovery of the vertebrate character of the skull of the reindeer, which he stumbled over during an excursion to the Hartz mountains. Such, too, was Goethe's dis[illegible] of the morpho[illegible] plants,—that th[illegible] parts of a [illegible]nt are only metamorphosed lea[illegible] The facts of an induction bein[illegible] given, a "Conception," as it is sometimes called, must step in, in order to afford a provisional support [illegible] temporary cause to the phenomena. Again, Conceptions not wholly correct may often serve [illegible] a Col[illegible]gation of facts until a better Colligation is afforded the facts. Thus, the *circular* motion of the heavenly bodies was for a long time only a conception; now it is known they move in elliptical orbits.—3. This third question has in a great measure been answered by the preliminary observations on the laws of nature. As soon as a process of induction has been completed, it then forms the ground for a legitimate induction. Analogy depends upon the principle that the same qualities may be assigned to distinct but similar objects, provided those qualities can be shown to accompany the poin[illegible] of [illegible]mblance in those objects, and not their points of difference. Thus, if we remark the analogy between man and a tree, and observe that they both grow gradually to a certain height, after which they both decay, and that both depend for their subsistence on receiving appropriate food, moisture, and air, we have noted those qualities which belong to them in common. But if we proceed farther with our analogy—"carry out our analogy," as the phrase is—we go wrong; for man is not stationary like a tree, neither does he grow up conically, and has no "bravery" of leaves. Reasonings involving Chance may likewise be admitted into inductive philosophy, for chance is just the amount of probability with which we expect one or other out of two or more uncertain events. The laws that govern this department of "probabilities" are various, and cannot be entered upon here.—4. New laws may be expressed,—1. by applying fresh definitions to old words; 2. names possessing an explanation of their own may have new ideas attached to them; 3. entirely new names may be invented, but accompanied always with a precise definition; 4. chemistry affords excellent examples of the mode of forming new names. The principles of inductive reasoning are afforded (*a*) by the senses, (*b*) by instruments, which constitutes properly observation, (*c*) by the testimony of others, (*d*) by the aggregate observations of men. No logical principle can be put into practice without the possibility of conscious or [illegible] *Err*[illegible] Where error is consciously unfolded, it is for the purpose of deceiving others, and is properly a Sophism; where it is unfolded unconsciously, we deceive ourselves and fall into a Paralogism. In either case we commit what logicians denominate a *Fallacy*. The causes and occasions of error arise as follows:—1. In the general circumstances which govern the intellectual character of the individual; 2. in the constitution and habits of his powers of thought, feeling, and desire; 3. in the language which he employs; 4. in the nature of the objects upon which he is engaged. Again, the fallacies which men are guilty of are properly of two classes,—formal and material. The formal fallacy most frequently occurs in the regular syllogism, [illegible]lly arises from the vice of having four instead of three terms. Under this genus are comprised three species. The material fallacy is the most frequent. It arises from making a universal conclusion where [illegible]e are not warranted to do so by the premises, or from a notion which is not in reality a middle term, we infer a conclusion. Some five or six fallacies belong to this genus. The various degrees of belief, according to Aristotle, are, 1. problematical, 2. assertory, or 3. demonstrable,—in other words, are the results of opinion, belief proper, and science. 1. The problematical judgment is [illegible]ither subjectively nor objectively true; it is neither m[illegible]ntained with complete certainty by the mind, nor [illegible] the object about which we judge be truly represented. Meanwhile, it is mere opinion, but it may afterwards become matte[illegible] of proof, and then this opinion is elevated to demonstrable truth. Every great discovery is at first a problem, or a thing to be proved; and it depends on the sagacity and genius of the investigator whether it is to take its place among the proven theorems of knowledge. The best course of conduct for us under doubtful circumstances, historical records about which there [illegible] conflicting testimony, and so forth, are all of this problematical character.—2. In the next place, the assertory kind of knowledge is one of which we are fully persuaded ourselves, but cannot lay down the grounds for our belief so as to compel men to side with us. It is subjectively true, but not objectively certain. We have what is called "a moral persuasion" of it, but cannot exhibit the common grounds of our conviction.—3. Demonstrative knowledge, again, is either subjectively or objectively true, or both. It may either be certain in itself, as an axiom in mathematics, or conditionally certain, as, The sun will rise to-morrow, if the laws of nature maintain their constancy.—*Ref.* On Pure Logic, consult *Lectures on Logic*, by Sir William Hamilton, 2 vols., 1860; *An Introduction to Logical Science*, by Professor Spalding, 1857, or the art. "Logic" in the 8th edition of the *Encyclopædia Britannica*; Archbishop Thomson's *Laws of Thought*, 5th edition, 1860; Archbishop Whately's *Elements of Logic*, 1850, &c. &c. On Material Logic, the best work is that of John S. Mill, *Logic, Ratiocinative and Inductive*, 2 vols., 1862.

Lo[illegible] (Gr. [illegible], a word; *grapho*, I write), [illegible] without having recourse to shorthand. It was put in practice during the French revolution. About twelve reporters arranged themselves round a table, each of them having a long slip of paper numbered before him. The first three or four words were taken down by the writer of No. 1; and as soon as they were spoken, he gave notice to his neighbour by touching his elbow, or some other [illegible]ign. No. 2 then passed the sign to No. 3; and so on [illegible]il the first line of each slip was completed, when No. 1 commenced the second line. When filled up, all the slips were placed parallel to each other, and formed a single page. Logography was not found to [illegible] practice; it required too great attention and quickness for correctness. It was first employed in the National Assembly, in October, 1790, and continued till the 10th August, 1792, when Louis XVI., with his family, took refuge from the insurrection in the Assembly, and occupied the box of the logographe: from that time it was discontinued. The term logography also denotes a mode of printing, in which whole [illegible]ords are used instead of letters. It was used for a short time in the *Times* printing office, but soon abandoned.

LOGOGRYPH, *log'o-grif* (Gr. *logos*, a word; *griphos*, an enigma), a word used by Ben Jonson, and almost obsolete, signifying a sort of riddle to exerc[illegible]e the mind.

LOGOS, *log'-os*, is a Greek term, [illegible] the [illegible]ord. In theological language, Logos, [illegible], is applied to the Son of Man. The Jews used the term *memra*, which corresponds to logos, or word, but as synonymous with Jehovah, or as denoting the mere token or symbols of the Divine presence. There are some eminent critics, however, who are of opinion that the Targumists employed this word to denote the future Messiah. The term logo[illegible], as used by Plato, is rather ambiguous. It is uncertain whether by it

he means to denote a distinct intelligent being, or merely the divine attributes of deity. "St. John," says Professor Burton, "was as far as possible from being the first to apply the term *logos* to Christ. I suppose him to have found it so universally applied, that he did not attempt to stop the current of popular language, but only to keep it to its proper channel, and guarded it from extraneous corruptions." He holds that it is one of the peculiar objects of St. John's Gospel to show in what sense the term *logos* can properly be applied to Christ. Mystical notions regarding the logos were derived, by the Christian Platonists, from the school of Alexandria, and hence many of the Fathers maintained that the Logos was an attribute of God, and that this attribute became the person of the Son, and was afterwards united to Jesus Christ. The Unitarians consider the word logos to be applied either to God himself, or to certain of his attributes; as reason or [illegible]. The Arians look upon the Logos as an [illegible] the Supreme Being, superior to all other created beings, and which supplied the place of a human soul in Christ. Dr Lardner, in his "Letter on the Logos," states that he was at first favourable to the doctrine that the Logos was the soul of Christ, but being at a loss to conceive how that high being, the highest of God's creatures, should gain any exaltation by receiving, after his resurrection, and ascension, a bright resplendent human body, and being made lord and king of men, the judge of the world, and higher than the angels, to whom he was vastly superior before, abandoned this hypothesis as throughout inconceivable and irreconcilable to reason. Trinitarians regard the term as being specially appropriate to Christ, who is a revelation of God the Father unto men.

LOGWOOD, *log'-wood*, a very valuable dyestuff, consisting of the cuttings or raspings of the wood of the *Hæmatoxylon campechianum*, a tree growing in Mexico and the neighbouring countries. [illegible] for dyeing black with alum; but [illegible] to red immediately. Its dyeing properties are due to its containing a crystalline matter called *hæmatoxylon*, which is straw-yellow in its pure state, but assumes a brilliant red under the influence of oxygen and alkalies.

LOIMIC, *lo-im'-ik* (Gr. *loimos*, contagion), in Med., denotes relating to the plague, or to contagious disorders.

LOINS, *loins* (Welsh *llwyn*), is applied to the lower and posterior part of the trunk of the body, or the space between the upper edge of the pelvis and the last of the ribs. The lower end of the vertebral column is in this region, and the vertebræ composing it are termed the lumbar vertebræ.

LOLLARDS, *lol'-lardz* (Ger. *Lollharden*), were a class of persons who appeared in Germany and the Netherlands about the beginning of the 14th century. The name is believed to [illegible], or *lollen*, to sing with a low voice, and the termination *hard*, denoting frequency, and not, as some are of opinion, from Walter Lollard, who suffered martyrdom at Cologne in 1322. A number of pious laymen formed themselves into a society at Antwerp, for the purpose of visiting the sick and burying the dead during a season of pestilence, when the clergy deserted their duties. They soon spread to other parts, and succeeded in attracting the attention and love of the great mass of the people. On this account they excited the envy of the clergy, who accused them of holding many heretical opinions. Doubtless, too, they may have held certain opinions at variance with the teaching of the Church of Rome, but there is no shadow of ground for accusing them of holding the extreme views, or of practising the vicious conduct, that has sometimes been attributed to them. The term came afterwards to be applied generally to all who were believed to hold heretical opinions; and hence the followers of Wickliffe were called Lollards.

LOMBARD, *lom'-bard*, was a term frequently applied in England to a banker or money-lender, from the Lombards, a company of Italian merchants, chiefly from Lombardy, who were settled in London as early as the middle of the 13th century, and had their residence in a street which still bears their name. These were the great bankers and money-lenders of the day. Stow, in his "Survey of London," says, "Then have ye Lombard Street, so called of the Longobards, and other merchants, strangers of divers nations, assembling there twice a day."

LOMBARDIC ARCHITECTURE. (*See* ROMANESQUE ARCHITECTURE.)

LOMENTUM, *lo-men'-tum* (Lat.), in Bot., a kind of fruit. It may be described as a *legume* or *pod*, which is contracted between each seed in a moniliform manner. When ripe, the lomentum commonly separates into as many pieces as there are contractions on its surface, sometimes, however, it remains entire.

LONDON CLAY, *lun'-dun klai*, a term applied in Geol. to the older group of regularly-deposited tertiary strata in England. It is distinguished from the more recent group, which is called "crag." The different strata which together compose what is called the London clay deposit, are chiefly exhibited in basin-shaped depressions in the chalk, one of which occurs between the line of the North Downs and the chalk of Cambridgeshire, Hertfordshire, and Suffolk; and another between the South Downs and the continuation of the same range into Dorsetshire and the English Channel: the former is called the London, and the latter the Hampshire basin. In the Isle of Wight there is also a third basin, remarkable for the presence of some fresh-water fossiliferous strata, not found in the other parts of the formation. London clay proper consists of tenacious brown and bluish-grey clay, with layers of concretions called septaria, which chiefly abound in the brown clay, and are [illegible] quantities from [illegible] off the Essex coast, to be used in the manufacture of Roman cement. The principal localities of fossils in the London clay are Highgate Hill, near London, the Isle of Sheppey, and Bognor, in Hampshire. The total thickness of the London clay amounts to considerably more than a thousand feet. Its lower part consists of an indefinite number of beds of sand, shingle, clay, [illegible] loam, irregularly alternating with one another, and formerly looked upon as a distinct formation, and described under the name of the "Plastic Clay." For more than half a century the strata called London and Plastic clay in England have been studied, and about 400 species of [illegible] of fish, besides several kinds of chelonian and saurian reptiles, were known before a single mammifer was detected. At length, in the year 1839, there were found in this formation the remains of a monkey, an opossum, a bat, and a species of the extinct Hyracotherium, allied to the Peccary or Hog tribe. Some years later, in 1846, the jaw of another British species of fossil monkey, *Macacus pliocenus*, was announced by Mr. Owen as having been met with in the newer pleiocene strata in Essex, along with the remains of the hippopotamus, elephant, and other quadrupeds. The presence of the fossils of crocodiles, turtles, shells of the genus nautilus, and many curious fruits, lead geologists to believe that the climate of the era when the London clay was deposited was warm, and nearly tropical.

LONG, *long* (Lat. *longus*), the name applied in ancient music to that note which was second in duration to the Large, and equal to two breves, or four semibreves, or eight minims, or sixteen crotchets; and so on.

LONGEVITY, *lon-jev'-e-te* (Lat. *longa vita*, long life), signifies length of life. After the creation of the world, when its inhabitants were few, the age of man was much longer than it now is. The age of the greatest part of those recorded to have lived before the Flood was upwards of 900 years. After the Flood, Shem is the only one that we read of that reached the age of 500. In the 2nd century we do not find that any reached the age of 240; and in the 3rd century (about the latter end of which Abraham was born), none except Terah arrived at 200. By this time the world was so well peopled that they had built cities, and were formed into distinct nations, living under their respective kings. By degrees, as the number of people increased, their longevity decreased, till it came down at length to 70 or 80 years; and there it has stood ever since. Instances, however, are by no means rare of persons who have exceeded that limit. According to the census of Great Britain in 1851, more than 129,000 had passed the limit of fourscore years; nearly 10,000

had lived 90 years or more. A band of 2,038 aged pilgrims had been wandering 95 years, or more, on the unended journey, and 319 reported that they had witnessed more than 100 revolutions of the seasons. Many instances are cited of men living in the ancient world more than 100 years; and Lord Bacon, in his "History of Life and Death," quotes as a fact unquestioned, that, a few years before he wrote, a morris dance was performed in Herefordshire, at the May games, by eight men, whose united ages amounted to 800 years. In the 17th century, some time after Bacon wrote, two Englishmen are reported to have died at ages greater than almost any of those which have been attained in other nations. According to documents which are printed in the "Philosophical Transactions of the Royal Society," Thomas Parr lived 152 years and 9 months, and Henry Jenkins 169 years. The evidence, however, in these cases is by no means conclusive, as it evidently rests on uncertain tradition and on the very fallible memories of illiterate old men. There is every reason to believe that as civilization extends, as the laws that affect health are understood and acted upon, the duration of life will be much increased. Instances of longevity show what the human frame is capable of attaining to; and as the laws of health come to be more acted upon, healthier parents will give birth to healthier children from generation to generation; indeed, there are not wanting those who look upon the natural duration of life as a hundred years, and who literally receive the language of the prophet, that "there shall be no more thence an infant of days, nor an old man that hath not filled his days; for the child shall die a hundred years old, but the sinner being a hundred years old shall be accursed. And they shall build houses and inhabit them; and they shall plant vineyards and eat the fruit of them. They shall not build and another inhabit; they shall not plant and another eat: for as the days of a tree are the days of my people, and mine elect shall long enjoy the work of their hands."—(Isaiah lxv. 19—22.) The preservation of health ought to form an essential part of municipal and national policy.—(*See* SANITARY SCIENCE.)

LONGICORNS, *lon'-je-korns* (Lat. *longus*, long; *cornu*, a horn), an order of coleopterous insects, so called on account of the length of their antennæ, which are generally longer than their bodies, and very seldom shorter. Longicorn insects also possess other distinctive characters. The under part of the first three joints of the tarsi, in all of them, is furnished with a brush; the second and third joints are cordiform, the fourth is deeply bilobate; and at the base of the last there is a little nodule, resembling a joint. The antennæ are either filiform or setaceous, being sometimes simple in both sexes, and sometimes serrate, pectinate, or flabelliform in the males. In some species, the eyes are rounded and entire; in others, slightly emarginate; in the latter case, the thorax is trapezoidal or narrowed anteriorly. In most cases, however, the eyes of the longicorns are reniform, and surround the base of the antennæ. The larvæ of a great number of the longicorns are destitute of feet, or have very minute ones, as a large proportion of them live in the interior of trees or under the bark. Their body is soft, whitish, and thickest in the fore part; and the head is squamous, and furnished with strong mandibles. The larger varieties of the longicorns often do great damage to trees, sometimes drilling them in every direction. Some species attack the roots of plants.

LONGISSIMUS DORSI, *lon-jis'-si-mus dor'-si* (Lat., the longest [muscle] of the back), in Anat., is a muscle of the back, which rises from the posterior surface of the os sacrum and transverse and oblique processes of the lumbar vertebræ, and is inserted by small double tendons into the posterior and inferior part of all the transverse processes of the vertebræ of the back, sending off also bundles of fibres to all the ribs between their tubercles and angles. Its use is to support the spine, and bend it backwards and to one side.

LONGITUDE. (*See* LATITUDE AND LONGITUDE.)

LONGUS COLLI, *long'-gus kol'-li* (Lat., the long [muscle] of the neck), in Anat., is a muscle situated close to the anterior and lateral part of the vertebræ of the neck. It rises from the three superior vertebræ of the back, and is also connected by tendons with the four last vertebræ of the neck, being inserted into the fore part of the second vertebra of the neck, near its fellow. Its use, when acting singly, is to move the neck to one side, but when both act, they serve to bring the neck directly forwards.

LONICERA, or HONEYSUCKLE, *lon-is'-e-ra* (*Lonicera*, named after Adam Lonicera, a German botanist, who died in 1586), a gen. of very ornamental shrubs, closely allied to the genus *Caprifolium*. The species grow in any common soil, and are readily increased by cuttings taken off in autumn and planted [illegible] a sheltered situation. There are several [illegible] in England, amongst the best known of which are,—1 The pale perfoliate honeysuckle (*L. caprifolium*), which grows in woods and thickets, but is not common; when it meets with support, it grows to a considerable height. The leaves are sometimes used in detersive gargles. 2. Common honeysuckle, or woodbine (*L. periclymenum*), is a common shrub in almost every grove, thicket, and hedge, and flowers from June to October. This is a favourite plant in gardens and shrubberies. Goats are very partial to the leaves of woodbine, for which reason the French call the plant *chèvre-feuille* (goat-leaf). 3 The upright fly honeysuckle, a species which flourishes in thickets and rocky places. It is a shrub of little beauty, and no known utility. The flowers, however, of several of the species are highly fragrant and ornamental, and the form of the common European honeysuckle is supposed to have given rise to one of the most beautiful ornaments of Grecian architecture.

LOOKING-GLASS. (*See* MIRROR.)

LOOM, *loom* (Ang.-Sax.), a machine or framework of wood or metal, for manufacturing cloth by interweaving a series of parallel threads, which run lengthwise [illegible] called the *warp*, with another series of threads which run [illegible] called the *woof* or *weft*, by means of the [illegible]. (*See* WEAVING.)

LOOSESTRIFE. (*See* LYTHRACEÆ.)

LOQUAT, *lo'-kwat*, the fruit of the *Eriobotrya japonica*, a rosaceous plant.

LORANTHACEÆ, *lo-ran-thai'-se-e*, in Bot., the Misletoe fam., a nat. ord. of *Dicotyledones*, sub-class *Monochlamydeæ*. Parasitic shrubby plants. Leaves commonly opposite, exstipulate, greenish. Flowers perfect or diœcious, calyx superior, with 3—8 divisions, æstivation valvate,—sometimes the calyx is absent, stamens equal in number to, and opposite, the lobes of the calyx, ovary inferior, 1-celled, with 1—3 ovules, erect or suspended, and a free central placenta. Fruit commonly succulent, 1-celled, with a solitary seed, embryo in fleshy albumen, with radicle remote from the hilum. Miers has separated this order into two, *Loranthaceæ* and *Viscaceæ*, the former being characterized by its large showy crimson dichlamydeous perfect flowers; and the latter by its pallid diœcious monochlamydeous flowers. Lindley and Bentley do not adopt this division. The plants of the order are more remarkable for their curious mode of growth than for their useful properties. One species, *Loranthus tetrandus*, a native of Chili, produces a black dye. The mistletoe yields a viscid pulp, used for making birdlime. (*See* VISCUM.)

LORCHA, *lor'-ka*, is the name of a coasting vessel used in the Chinese seas. It was the boarding of one of these vessels, sailing under the British flag, by the Cantonese, that led to the war with China in 1856.

LORD, *lord* (Sax. *hlaford*, *laford*, contracted lord), denotes a ruler or governor. It primarily denotes a bread-giver, from *hlaf*, bread, and *ford*, to give or afford. In feudal times the lord (*seigneur*) was the grantor or proprietor of the land, who retained the dominion or ultimate property of the feud or fee; and the grantee, who had only the use or possession of the land, was styled the feudatory or vassal. A person who has the fee of a manor, and consequently the homage of his tenants, is called the lord of the manor. The superior lord is styled lord paramount, and his tenants, if they grant a portion of the land to other persons, while they remain tenants in reference to the lord paramount, are lords in reference to their own tenants, and are hence styled mesne or middle lords. Lord in gross is one who is lord not by reason of any manor; as the king in respect of his crown.

Very lord is he who is immediate lord to his tenant, and very tenant he who holds immediately of his lord. Thus, where there is a lord mesne, he is very lord to his tenant, and not the lord paramount. Lord is also a mere title of dignity attached to certain official stations, which are sometimes hereditary, but sometimes only official or personal. All who are noble by birth or creation, otherwise called lords of parliament and peers of the realm, are styled lords. The five orders of nobility constitute the lords temporal, distinguished from the prelates of the Church, who constitute the lords spiritual in the House of Lords (*See* PARLIAMENT.) Lord is also applied to persons holding certain offices; as the lord chief justice, the lord mayor, &c. It is likewise given by courtesy to the sons of dukes and marquises, and to the eldest sons of earls. In the authorized translation of the Scriptures, it is used, without much discrimination, for all the names applied to God, but when it represents the great name of Jehovah, it is printed in small capitals. In the New Testament, it is applied to Jesus Christ, the term in the original Greek being *kurios* (owner or master).

LORD ADVOCATE is the principal law officer of the crown in Scotland, analogous to the Attorney-General in England. He has to plead in all causes that concern the crown, and he also acts as public prosecutor. He exercises a superintending power over all prosecutions in inferior courts and the general administration of criminal justice, and has the nomination of a certain number of deputes. These deputes assist him in the Court of Justiciary, and are despatched by him to the several circuits of that court to prosecute indictments there. He and his deputes have power to pass from or restrict any charge. He can prosecute, independently of the private party, in any court, superior or inferior; but he cannot be compelled to prosecute. He has a seat in the House of Commons, and [illegible] during the sitting of parliament, introducing su[illegible] as relate to Scotland, and taking charge of their details in passing through the house. He is also the adviser of the government in all matters of difficulty connected with Scotch affairs, and is in constant confidential communication with the home secretary of state, and transacts many of those duties in Scotland which in England form the business of the home secretary. He receives a salary of £1,500, with £1,000 additional as a commutation for his fees in the justiciary business. The office is not very ancient; for it seems to have been established about the beginning of the sixteenth century. Previous to that time, indictments seem to have been under the superintendence of the clerk of court, or justice-clerk. (*See* JUSTICE-CLERK.)

LORD KEEPER, an ancient officer of the crown, who was intrusted with the custody of the great seal, with authority to affix it to public documents. He was created by the mere delivery of the king's great seal into his custody, without writ or patent. Prior to the reign of Henry III. the office of keeper of the great seal appears to have been distinct from that of chancellor; but in that reign both offices were conjoined in Ralph Nevill. The act 5 Eliz. c. 18, declared that the same place, authority, and power belonged to the office of the lord keeper of the great seal as to that of lord chancellor. Now the lord chancellor is keeper of the great seal, and when there is no chancellor, it is ordinarily put in commission. (*See* CHANCELLOR.)

LORD LIEUTENANT OF IRELAND is the chief executive officer of the Irish government, representing, in some respects, the power and majesty of the crown. Before the legislative union of that country, and when the means of communication were slow and difficult, the lord lieutenant wielded the powers of the crown almost as completely as the monarch himself could have done during any temporary residence in that country. By degrees, however, this functionary has been stripped of much of his regal independence, and practically he is now little more than the resident official through whom the secretary of state for the home department conducts the government of that country. It now rarely happens that the lord lieutenant takes any important step without the advice and sanction of the home secretary. In cases of sudden emergency, however, his power of independent action is complete, and of as much authority as that of the crown. He is always a nobleman of high rank and commanding station, and maintains an establishment of a regal character, holding courts, levees, and drawing-[illegible] and conferring the honour of knighthood. He [illegible] the sword of state as a symbol of his viceregal power. He is at the head of the administration of justice, and has power to pardon criminals or to commute their sentences. His household consists of a private secretary, steward, comptroller, chamberlain, gentleman usher, master of the horse, and subordinate officers. He has a fixed yearly salary of £20,000 and two residences, one in Dublin Castle, another in Phœnix Park. In the discharge of his public duties he enjoys the assistance of a privy council composed of the great officers of the crown in Ireland, and others appointed by the crown. His chief secretary, who may be said to be his prime minister, exercises many of the vice-regal functions. He is usually a member of the House of Commons, of considerable ability, and chiefly manages the affairs of the Irish government in London, having for that purpose an establishment of under-secretaries and clerks, both in London and Dublin. Both these high officers resign on the formation of a new ministry.

LORDS LIEUTENANT OF COUNTIES are permanent provincial governors appointed by the crown by letters patent under the great seal, and holding office during pleasure. These officers began to be introduced as standing representatives of the crown to keep the counties in military order about the reign of Henry VIII. or his children, previous to which it was usual for the kings, from time to time, to issue commissions of array, and to send into every county officers in whom they could confide, to muster and array (or set in military order) the inhabitants of every district. The lords lieutenant are generally of the principal nobility, and of the best interest in the county. They are at the head [illegible] chief authority is military, and is exerted for the preservation of the peace, for which they are considered responsible within their respective counties. They have the nomination of the entire staff of deputy-lieutenants and of the officers of the militia and volunteer corps, and also for the commission of the peace. He is also an officer under the lord chancellor, having charge of the records of the county, and appoints the clerk of the peace. The lords lieutenant are appointed from party motives, but hold their offices independent of politics, for life.

LORD OF MISRULE was the title borne by the master of revels at Christmas, in any nobleman's or other great house. "First in the feast of Christmas," says Stow, "there was in the king's house, wheresoever, a lord of misrule or master of merry disports, and the like had ye in the house of every nobleman of honour or good worship, were he spiritual or temporal." "These lords, beginning their rule at Allhallows eve, continued the [illegible] till the morrow after the feast of the Purification, commonly called Candlemas-day; in which space there were fine and subtle disguisings, masks, and mummeries, with playing at cards for counters, nayles, and points in every house, more for pastime than for gain." According to an original draft of the statutes of Trinity College, Cambridge, founded in 1546, one of the masters of arts is to be placed over the juniors every Christmas for the regulation of their games and diversions at that season of festivity. Under his direction and authority, Latin comedies and tragedies were to be exhibited in the hall; as also six *spectacula*, or as many dialogues. His sovereignty was to last during twelve days at Christmas, and he was to exercise the same power on Candlemas-day. A Christmas prince, or lord of misrule, was also a common temporary magistrate in the colleges at Oxford. At the inns of court, too, a Christmas prince, or revel-master, was constantly appointed. The lords of misrule in colleges were preached against at Cambridge in the reign of James I. as inconsistent with a place of religious education, and as a relic of the pagan ritual. They disappear after 1640. In Scotland, where the Reformation took a more severe and gloomy turn than in England, the Abbot of Unreason, as he was called, was suppressed by legislative enactment as early as 1555.—*Ref.* Brand's *Popular Antiquities*.

LORD PRIVY SEAL is the fifth great officer of state

in England. His office is one of great trust, honour, and dignity. He derives his title from the fact of his having the custody of the privy seal, which he must not put to any grant without good warrant under the monarch's signet; nor to any warrant if contrary to law and custom, or inconvenient, without first acquainting his sovereign therewith. This seal is used to all charters, grants, and pardons signed by the sovereign before they come to the great seal. The lord privy seal is appointed by letters patent, is a privy councillor by his office, and takes place next after the lord president of the council, and before all dukes. His salary is £2,000 per annum.—*Ref.* Thom's *Book of the Court*.

Lord's Day (Lat. *dies dominica*) was the term generally made use of by early Christian writers to distinguish their sabbath from that of the Jews, as well as from the Sunday of the pagans. Regarding the institution of this day as one specially set apart for religious worship, we find little information in the New Testament; we are only told of one occasion on which the disciples came together on the first day of the week to break bread, when Paul preached unto them. It is not till the time of Justin Martyr (A.D. 140) that we find a distinct account of its observance; he states that Christians were in the practice of assembling for public worship on the first day of the week, as being that on which the work of creation was commenced, and on which Christ rose from the dead. According to Eusebius, "Christ, by the new covenant, translated and transferred the feast of the Sabbath to the morning of light, and gave, as the symbol of true rest, the saving Lord's day, the first day of the week. On this day we do those things according to the spiritual law, which were decreed for the priests to do on the sabbath; all things proper to do on the sabbath we have transferred to the Lord's day." The early Church, for several centuries, kept both the Jewish sabbath and the Lord's day, the former being observed as a fast, or season of preparation for the latter. The council of Laodicea, A.D. 364, at length reprobated this practice, and condemned those who abstained from work on the seventh day, "for it was Judaizing; but on the Lord's day men should rest as Christians." Constantine the Great (A.D. 321) first made a law for the proper observance of the Lord's day. Though the practice was to abstain from worldly callings on that day, a portion of it at least came to be devoted to sports and pastimes, such as are still common in continental countries. Plays are said to have been performed on Sunday at the court of Queen Elizabeth, and even of Charles I.; and James I., in his "Book of Sports" (1618), declares that dancing, archery, leaping, vaulting, May games, Whitsun ales, and morris-dances, were lawful on Sundays after evening service. By the laws of King Athelstan, all merchandizing was forbidden on the Lord's day, under severe penalties, and by 27 Henry VI. c. 5, no fair or market should be held any Sunday (except the four Sundays in harvest), pain of forfeiting the goods exposed for sale. By 1 Eliz. c. 2, all persons, without lawful excuse, are to resort to the parish church on Sundays, or to forfeit twelve pence. By 1 Car. I. c. 1, no persons shall assemble out of their own parishes for any sports whatsoever upon this day, nor in their parish shall use any bull or bear-baiting, interludes, plays, or other unlawful exercises or pastimes, on pain that every offender must pay 3*s* 4*d* to the poor. By 29 Car. II. c. 7, no tradesman, artificer, workman, labourer, or other person whatsoever, shall do or exercise any worldly labour or business, or work of their ordinary callings, on the Lord's day (works of necessity and charity only excepted); and it also prohibits the sale and hawking of wares and goods. By 21 Geo. III. c. 49, no house or other place shall be opened or used for public amusement, or public debate on any subject whatever, upon any part of the Lord's day. The statute 29 Car. II. c. 7, is still regarded as the basis of the law on this subject, and being prohibitory, it is construed rigorously. Thus the words "any worldly labour" are limited to works of one's ordinary calling; and a man who sold a horse on Sunday was allowed to recover the price thereof, as it was not his ordinary calling; and a contract of hiring between a farmer and a labourer on Sunday has been held to be good. The words "other person whatever" are restricted to persons of the same classes as those enumerated by name; and hence drivers and proprietors of stage coaches are not included, and a contract to carry passengers on Sundays is valid. A bill of exchange drawn on Sunday is not void. In law, this is a *dies non juridicus*, a day on which no law proceedings can be taken; but an arrest for crime can be effected on this day; and bail can arrest their principal, and a sergeant-at-arms can apprehend. (*See* SABBATH.)

Lords, House of (*See* PARLIAMENT.)

Lord's Supper (*See* EUCHARIST.)

Lorica, *lor-i'-ka* (Lat. *lorum*, a thong), a cuirass, or coat of mail, worn by the ancient Greek and Roman soldiers. At first, the cuirass was made of linen, but afterwards pieces of horn, cut in the shape of scales, were bored and sewn together, so that the scales overlapped one another, and in general appearance resembled the surface of a green fir-cone. These loricæ were used in hunting, and not in fighting. The use of cuirasses of this sort immediately preceded the wearing of metallic scale armour. The basis of the lorica was sometimes a skin, or a piece of strong linen; and the front was frequently ornamented with enriched bronze shoulder-bands, beautifully embossed.

Lorimer, *lor'-e-mer* (Fr. *lormier*), a word now obsolete, which signified a bridle-maker, or one who made bits, spurs, and metal mounting for military bridles and saddles.

Lory, *lo'-re*, a bird of the Parrot fam.,—the *Psittacus Lorius* of Linnæus; sub-fam. *Lorianæ*. The characteristics are,—bill only slightly curved; the margin of the upper mandibles sinuated; the notch obsolete; lower mandible slender, conic, much longer than high; the gonys (typically) straight.

Lotion, *lo'-she-on* (Lat. *lotio*), is a form of medicine made up of a solution of various medicinal substances in water or some other liquid, and designed for external application. They serve various purposes, according to the ingredients of which they are composed, some tending to allay pain, others to stimulate indolent tumours; some to reduce the inflammation of a part, others to remove deformities. Many of the nostrums that are sold as lotions are composed of very active substances, and frequently produce very serious effects.

Lots, *lots* (Sax. *hlot*), is a method of determining an uncertain event by an appeal to the providence of God, frequently alluded to in Scripture. The manner of casting lots is not particularly described. It is the opinion of some that the stones, or marks, which were used in determining the lot were thrown together into the lap or fold of a garment, or into an urn or vase, and that the person holding them shook them violently, so that they should be thoroughly commingled and prevent all preference by the hand of him that was to draw. "The lot is cast into the lap, but the whole disposing thereof is of the Lord" (Prov. xvi. 33). The choice of the apostle Matthias was by lot; Jonah was discovered by lot as the one who had offended God; and the division of the promised land among the different tribes was expressly commanded to be by lot. The orders of the priests and their daily services were also assigned by lot. The use of lots is a distinct appeal to the providence of God, and can only be regarded as a species of taking God's name in vain, when resorted to lightly or in trivial matters, or where a solution of the doubt is possible in any other way. Wantonly and without necessity to make this appeal is, therefore, highly blameable. The Moravian Brethren have recourse to the lot in the case of marriage and other appointments in their community,—though they are not determined solely by it. The use of lots has always been more or less resorted to among nations but little advanced in civilization, and less guided by reason than by superstitious beliefs. The Greeks and Romans were accustomed to divine auguries from lots by having each of them marked with a prophetic verse or other inscription.

Lotteries, *lot'-ter-ees* (from *lot*), are games of chance, in which, by payment of a small sum, one has the chance of obtaining a considerable prize. Most European states have had recourse to lotteries as a means of raising a revenue. The earliest English lottery of which we have any record was in 1569, when

40,000 chances were sold at ten shillings each, the prizes consisting chiefly of plate, and the profits going for the repair of certain harbours. Private lotteries soon became very common, and being generally conducted on fraudulent principles, an act of parliament was passed early in the reign of Queen Anne, suppressing them "as public nuisances." In 1694, a loan of a million was raised by the sale of lottery tickets at £10 each, the prizes in which were funded at the rate of 14 per cent. for sixteen years certain; and in 1710 a million and a half was raised by £10 tickets, each ticket being entitled to an annuity for thirty-two years, the blanks at 14s. per annum, the prizes in sums varying from £5 to £1,000 per annum. From that time up to the year 1824, the passing of a lottery bill was in the programme of every session. Up to about the close of the 18th century the prizes were generally paid in the form of terminable and sometimes of perpetual annuities. Loans were also raised by granting a bonus of lottery tickets to all who subscribed a certain amount. In 1778 an act was passed obliging every person who kept a lottery-office to take out a yearly license, and to pay £50 for the same. In 1808 a committee of the House of Commons was appointed to inquire "how far the evils attending lotteries had been remedied by the laws respecting the same;" and they reported that "the foundation of the lottery system is so radically vicious, that your committee feel convinced that, under no system of regulations that can be devised, will it be possible for parliament to adopt it as an efficacious source of revenue, and, at the same time, divest it of all the evils of which it has hitherto proved so baneful a source." At length, in 1823, the last act that was sanctioned by parliament for the sale of lottery tickets contained provisions for putting down all private lotteries, and for rendering illegal the sale, in this country, of all tickets in any foreign lottery. a pr[illegible] which [illegible]ely [illegible]d. Lotteries for productions of art in Art Unions were legalized by 9 & 10 Vict. c. 48. State lotteries were long carried on by the French government, but they were at length abolished in 1836. They are still carried on in the Austrian dominions and in several of the smaller German states. Lotteries are productive of the greatest evils to society, as may be abundantly seen from the report of the parliamentary commissioners already referred to. "The chance of gain,' says Adam Smith, "is by every man more or less overvalued, and the chance of loss is by most men undervalued." "The world neither ever saw, or ever will see, a perfectly fair lottery, or one in which the whole gain compensated the whole loss; because the undertaker could make nothing by it. In the state lotteries the tickets are really not worth the price which is paid by the original subscribers, and yet commonly sell in the market for twenty, thirty, and sometimes forty per cent advance. The vain hope of gaining some of the great prizes is the sole cause of this demand. The soberest people scarce look upon it as a folly to pay a small sum for the chance of gaining ten or twenty thousand pounds, though they know that even that small sum is perhaps twenty or thirty per cent. more than the chance is worth. In a lottery in which no prize exceeded twenty pounds, though in other respects it approach much nearer to a perfectly fair one than the common state lotteries, there would not be the same demand for tickets. In order to have a better chance for some of the great prizes, some people purchase several tickets, and others small shares in a still greater number. There is not, however, a more certain proposition in mathematics than that the more tickets you adventure upon the more likely you are to be a loser. Adventure upon all the tickets in the lottery, and you lose for certain; and the greater the number of your tickets, the nearer you approach to this certainty."—*Wealth of Nations*, book i. c. 10.

LOTUS. (*See* NELUMBIUM, NYMPHÆA, and ZIZYPHUS.)

LOUIS D'OR, *lu-e-dor'* (Fr., louis of gold), a French gold coin, which receives its name from Louis XIII., under whom it was first struck, in 1641. It has fluctuated in value, but was usually about 20s. sterling. They ceased to be struck in 1810, being replaced by the Napoleon of 20 francs.

LOUSE, *louse* (Sax. *lus*), a term applied to certain disagreeable and unseemly parasitic insects. They are distinguished by having six feet formed for walking, a mouth furnished with a proboscis, antennæ as long as the thorax, with the abdomen, which is formed of several segments, depressed. Many, if not all mammals, and perhaps all species of birds, are infested with lice; and it would appear that each species of mammal and bird has its own peculiar species of louse, and sometimes even two or three distinct species. They breed very rapidly, several generations occurring in a short period. Their increase seems to be favoured by certain circumstances,—as infancy, and that condition of the system which gives rise to *phthiriasis*, or the lousy disease. The human species is subject to the attacks of several species, among which are the *Pediculus humani corporis*, or body louse, principally occurring in adults who are dirty in their personal habits, and the *P. humani capitis*, or common louse, most frequent in children. The best antidote against these disgusting insects is cleanliness. Although of rare occurrence now, the lousy disease was not unfrequent among the ancients. Herod, Antiochus, Callisthenes, Sylla, and many others, are supposed to have perished from this complaint. The genus *Phthirus* differs from the *Pediculus* in having the body wide and rounded, the thorax very short and confounded with the body; the anterior feet are simple, and the two hinder pairs are didactyle. Among some nations, the louse is looked upon as a gastronomic luxury, and at one time it was considerably used in medicine. (*See* EPIZOA.)

LOUVRE, *loor(r)*, is the name of a celebrated public building of Paris, situated in the N. part of the city, near the right bank of the Seine. In the time of Dagobert, a hunting-seat existed here, the woods extending over all the space which is now occupied by the northern part of the city down to the banks of the Seine. It was converted into a stronghold by Philip Augustus in 1214, and used as a state prison. Charles V. (1364-80) added some embellishments to it, and brought thither his library and his treasury; and Philip I., in 1528, erected that part of the palace which is now known as the Gallery of Apollo. Henry IV. laid the foundation of the gallery which connects the Louvre on the south side with the Tuileries. Louis XIII. erected the centre; and Louis XIV., according to the plan of the physician Perrault, the elegant façade towards the east, together with the colonnade of the Louvre. That monarch afterwards chose the palace at Versailles, and from that time to the middle of the 18th century the works were interrupted. They were again commenced, under the direction of M. de Marigny, but were again interrupted by the Revolution, when the Louvre was declared to be national property, and its contents roughly handled by the populace. When the great number of works of art seized in Italy by the armies of Napoleon made it necessary to assign a proper place for their reception, the architect Raimond was selected to conduct the work; and Percier and Fontaine, who, in 1803, were charged by Napoleon with its resumption, built the great staircase of the museum proper, the museums of ancient art, the Egyptian museum, &c. After the Restoration, the work was again brought to a standstill, and nothing was done until after the revolution of 1848. Two million francs were devoted by the provisional government to the repair of the old Louvre, under the direction of M. Duban, who restored the Apollo gallery. A resolution having been passed by the provisional government in favour of the completion of the whole building, the foundation stone of the new Louvre was laid on 25th July, 1852, and the work completed in 1857, at a cost of nearly six million francs. The Louvre now consists of two parts,—the old and new Louvre. The former is nearly a square, 576 feet long and 538 wide, and inclosing a quadrangle of about 400 feet square; its eastern façade, looking towards the church of St. Germain l'Auxerrois, is a colonnade of 28 coupled Corinthian columns, and is one of the finest works of architecture of any age or country. The new Louvre consists of two vast lateral piles of buildings, projecting at right angles from the two parallel galleries, which join the old Louvre with the Tuileries, and forming the eastern boundary of the Place du Carrousel. Turning into the Place Napoléon III., they present on each

side a frontage of 590 feet, intersected by three sumptuous pavilions, intended to accommodate the minister of state, the minister of the interior, and the library of the Louvre. Some of the galleries on the upper stories are set apart for permanent and annual exhibitions of works of art. In the central part of the building is the council-chamber, to be used as an assembly-room for the public bodies of the empire on the opening of the legislature, and on other solemn occasions. The Tuileries and the Louvre, both now completed and harmonized, may be regarded as forming together a single palace, of a magnitude and splendour which can be paralleled nowhere else. The total space covered or inclosed by the entire structure is nearly 60 acres.

Lovage. (*See* Levisticum.)

Love, *luv* (Sax. *lufian*), in Ethics, is one of the primary passions of the human mind, and in Theol. is the chief of Christian graces. It has been defined to be the internal feeling of good-will and kindness which one intelligent being bears to another, and the expression of that benevolence in words and acts which gratify and benefit another. In its full and proper sense, the inward emotion and the outward act are united; for neither the doing good nor wishing good to another can, of itself, in strict propriety, be termed love. Reciprocity is almost an essential element of love; all durable love is mutual. This passion forms one of the most prominent features of the Christian religion; and hence the incomparable superiority of Christianity to any other system of religion or morals. The sum of the [illegible] is love to God and love to our fellow-man. "We love God because he first loved us;" "If a man say that he love God and hate his brother, the truth is not in him." The love of man to his Maker has its origin and its sustentation in Scripture; for without revelation this love could not exist. The rationalist may [illegible] of nature, have co[illegible] but it is only when we come to know the personal and moral character of God, as a judge as well as a maker, a guide as well [illegible] and a red[illegible] The [illegible] object of revela[illegible] et forth [illegible] of love in which God in his Word has cond[illegible] place himself in regard to man, flow all human duties, hopes, and expectations. Love to man ensues from the universal love of God, as the one creator and governor of all men, who, in consequence, stand in the relation of brothers to one another. The claims of mutual love and service that ought to prevail among men are rooted and grounded in divine revelation. "It is this specific Christian affection,—the l[illegible] of [illegible] a brother, purified and enlarged by th[illegible] of being an object of Divine mercy and [illegible] as to become a properly Christian emo[illegible] ch is to actuate the disciples of Christ in their benevolent efforts for the good of others."—(Kitto's *Biblical Cyclopædia*.) The love of God is a fruit of the Holy Spirit, and can only exist in the souls which he has regenerated. It is essential to true obedience; for when the apostle declares love to be "the fulfilling of the law," he in effect declares that the law cannot be fulfilled without love, and that every action which has not this for its principle, however virtuous in appearance, is defective. "Love is not only the shortest and most compendious way to perfection, but the greatest height and pitch of it. The more we have of love, the nearer advances we make to God, who is love itself!" "Heaven is but a state of the more perfect and consummated love; and, therefore, the best thing we can practise on earth is to tune our hearts to this divine strain." "Love will draw along after it all other virtues, will perfect and improve them, and will at least hide those faults of them which it cannot correct." "By faith we live upon God, by obedience we live to him; but 'tis by love alone that we live in him, as St John saith, God is love, and he that dwelleth in love dwelleth in God and God in him."—(John Norris's *Letters concerning the Love of God*.) On what is commonly termed *Platonic love*, very mistaken ideas prevail. It is generally regarded as a pure spiritual affection, abstracted from all carnal desires and terminating in itself. The dialogue in which Plato treats of love is indeed very mystical and allegorical; but the thing principally intended to be brought out by him, and consequently that which ought to be understood by Platonic love, evidently is the ascent of the soul unto God by the steps of inferior and subordinate beauties,—from the many beauties to the chief beauty, that is, to God. The steps thereof are, according to his idea, as follows;—from the beauty of bodies to the beauty of the soul; from the beauty of the soul to the beauty that is in the offices of life and laws; and from thence to the beauty that is in the sciences; and lastly, from the beauty of the sciences to the immense ocean of beauty, that is, God, of whom he gives a noble and magnificent description, and details the happiness of him that shall enjoy him. Love is also used to denote that affection which becomes the bond of attachment and union between individuals of the different sexes, and makes them feel, in the society of each other, a kind of happiness which they experience nowhere else. "Nuptial love maketh mankind; friendly love perfecteth it, but wanton love corrupteth and embaseth it."—(*Bacon*.)

Love, Family of, in Eccl. Hist., a sect of religious fanatics that originated in Holland about the [illegible] the 16th century, and had for their founder a Westphalian named Henry Nicholas. He taught that the essence of religion consisted in the feeling of Divine love, and that it was a matter of perfect indifference what opinions men entertained respecting the Divine nature, provided their hearts burned with divine love. Dr. Henry More wrote against his sect in his "Explanation of the Mystery of Godliness."

Love-Feasts are a kind of religious social meetings, held periodically among the Methodists, and to which only members of their church are admitted. They are evidently in imitation of the *agapæ* or love-feasts of the early Christian Church.

Low Churchmen is a term originally applied to those who disapproved of the schism made in the Church by the non-jurors, or high-churchmen, who refused to acknowledge William III. as their lawful king [illegible] who form the [illegible] h, [illegible] authority [illegible] nd [illegible] the [illegible] dissenters.

Low Dutch and **High Dutch** are terms somewhat improperly used for Dutch and German. The confusion seems to have arisen from Deutsch signifying German in the language of that [illegible].

Lower Empire is a term applied to the Roman em[illegible] from the time of the [illegible] tablishment of its seat at Constantinople down to the time of the capture of that city by the Turks [illegible] the [illegible] of the Ro[illegible] do[illegible] the E[illegible] or Byzantine empire, and at a later period, as the Greek empire. Gibbon, in his "Decline and Fall of the Roman Empire," embraces the whole of this period. (*See* Byzantine Empire.)

Low German (Ger. *Plattdeutsch* or *Niederdeutsch*), is that softer German dialect which was formerly spoken over a great part of Germany, and which is even now the language of the common people in most parts of North or Lower Germany. It has also main[illegible] elt in some legal forms, thus the Hambu[illegible] oath of citizenship is in Low German. It is not, as is sometimes supposed, a corrupt language, but a distinct dialect as much as the High German, though circumstances have caused the latter to become the language of literature and of the educated classes. (*See* German Language and Literature.)

Lowlands, a term applied to the southern parts of Scotland, in contradistinction to the Highlands, which comprise the northern and western parts.

Low Sunday was applied to the first Sunday after Easter. It was a lower festival than Easter day, and some part of the service [illegible] to Easter-day was repeated on that day.

Lozenge, *loz'-enj* (Fr. *lo[illegible]*), in general language, a figure with four equal sides, having two obtuse and two acute angles: in geometry this figure is usually called a *rhomb*, and when the sides are unequal, a *rhomboid*. A *lozenge*, in heraldry, is a figure resembling a pane of glass in an old-fashioned casement, on which are represented the coats of arms of maidens and widows. In confectionery, a lozenge is a small cake of pressed

fruit, or of sugar, so called from its original rhomboidal form.

LUCIFERIANS, *lu-sif-e'-re-anz*, the name of a religious sect which arose in the 4th century, being founded by Lucifer, bishop of Cagliari, who was banished by the emperor Constantius for having defended the Nicene doctrine of the three persons in the Godhead. The persecutions he had undergone made him bitter and irascible, and his zeal on behalf of orthodoxy alienated even Athanasius against him He was particularly opposed to the Arians. The Luciferians spread mightily for a time in Gaul, Spain, Egypt, &c.; but they disappear in the follow[illegible]

LUCIFER MATCHES, *lu'-se-fer* [illegible], the name of the morning star, from *lux*, light, *fero*, I bring).—These little necessaries are made by dipping the tops of thin slips of [illegible] blue, and oxide of lead. The use of phosphorus in its ordinary condition is attended with very serious results to the workpeople engaged in the manufacture. The paste used constantly exhales phosphoric vapour, which is breathed by the workpeople, giving rise to bronchial affections of a severe character, caries of the teeth, and necrosis of the bones of the jaw. The danger, too, of using easily inflammable matches is very great, so much so that the French government at one time seriously contemplated the abolition of lucifer matches and a return to the primitive flint and steel Important improvements have lately taken place in the manufacture, by the successful introduction of the use of Schrötter's amorphous phosphorus instead of the ordinary kind, by MM Coignet in France and Messrs. Bryant and May in England. Being perfectly fixed at ordinary temperatures, the [illegible] enjoy an absolute immunity from th[illegible] mentioned above, and the amorphous phosphorus being only inflammable when rubbed in contact with chlorate of potash or black oxide of manganese, safety from accidental fire is insured by separating these two substances, the chlorate being placed on the match tip, and the amorphous phosphorus on the friction-tablet. Another great improvement has also been made in the use of stearine or paraffin, instead of sulphur, for rendering the wood splint more inflammable. The invention is equally applicable to wax vestas and to cigar-lights. The great centre of the match manufacture is at Vienna, where the four principal makers employ no less than 6,000 workpeople.

LUDDITES, *lud'-ites*, was the name given in England to the rioters who, in 1812, destroyed the machinery in the manufacturing towns. They were so called from one of their leaders named Ludd.

LUFF, *luff* (Dan *loeven*), a term used in Mar. when ordering the helmsman to put the tiller on the lee side, in order to make the ship sail nearer the wind, as, *Keep your luff*. It also designates the roundest part of the bow of the ship.

LUFFA, *luf'-fa* (from *louff*, its Arabic name), in Bot, a gen. of the nat. ord. *Cucurbitaceæ*, or Gourd fam *L. purgans* and *drastica* have fruits which are violently purgative. They constitute the drug commonly called *American colocynth*. The fruit of *L. fœtida*, termed the *sponge-gourd*, consists of a mass of fibres entangled together: those fibres are used for cleaning guns

LUGGER, *lug'-ger* (Du *logger*), a small vessel carrying two or three masts and a running bowsprit, upon which *lug sails*, and two or three jibs, are set. Topsails are sometimes adapted to them.

LUKE, GOSPEL OF ST., *luke*, is the third of the four gospels of the New Testament The genuineness and authenticity of this gospel are confirmed by the unanimous testimony of ancient writers. It is repeatedly cited by Justin Martyr; and all admit that, at the time of Irenæus and Tertullian, it was accepted throughout the whole church in its present form These testimonies are confirme[illegible] by a host of later writers, whose evidence has been collected by Dr Lardner. Notwithstanding this, there have not been wanting German critics to call in question the authenticity of this gospel, or particular parts of it. Luke was a physician, probably of gentile descent, and a frequent companion of the apostle Paul. That this gospel was specially written for the benefit of the gentiles, is evident, both from its general tenour as well as from its being dedicated to Theophilus, one of his gentile converts. He thus condescends to many particulars, and notices various points, for the benefit of those who were remote from the scene of action and ignorant of Jewish affairs. Hence, also, he is particularly careful in specifying various circumstances [illegible] facts that were highly conducive to the information of strangers, but which the Jews could supply from their own knowledge; on this account, he begins his history with the birth of John the Baptist, and traces Christ's lineage up to Adam, showing that he is the seed of the woman promised for the redemption of the world. He has likewise introduced many things not noticed by the other evangelists, tending to encourage the gentiles to hearken to the gospel; as the parables of the publican praying in the temple, the lost piece of silver, and the prodigal son; Christ's visit to Zaccheus, and the pardon of the penitent thief upon the cross. This gospel is divided by Rosenmuller and others into five distinct parts; viz.—1. Containing the narrative of the birth of Christ, together with all the circumstances that preceded, attended, and followed it (i.—ii. 40); 2. comprising the particulars relative to our Saviour's infancy and youth (ii 41-52), 3. including the preaching of John, and the baptism of Jesus Christ, whose genealogy is annexed (iii); 4. c[illegible] the discourses, miracles, and actions [illegible] during the whole of his ministry (iv.—ix. 50); 5. containing an account of our Saviour's last journey to Jerusalem, with all the circumstances relative to his passion, death, resurrection, and ascension (ix. 51—62, x.—xxiv). The style of this gospel is pure, copious, and flowing, and bears a considerable resemblance to that of [illegible] Paul. From his medical knowledge, he h[illegible], with singular accuracy and skill, the various diseases which he had occasion to notice. With regard to the time when this gospel was written, some difference of opinion exists, but the majority of critics are now agreed in judging it to have been about the year 63 or 64—*Ref.* Horne's *Introduction to the Sacred Scriptures*.

LUMBAGO. (*See* RHEUMATISM)

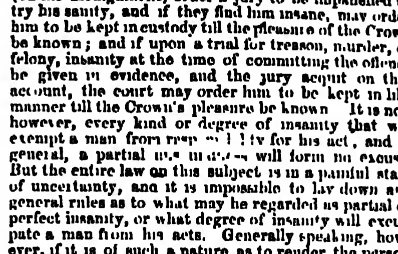
LUMBAR, *lum'-bar* (Lat. *lumbus*, the loin), in Anat, denotes of or belonging to the loins, as, lumbar region, &c (*See* LOINS)

LUNACY, *lu'-na-se* (Lat. *luna*, the moon)—"A lunatic," says Blackstone, "is one that hath had understanding, but by disease, grief, or other accident, hath lost the use of his reason; he is, indeed, properly, one that hath lucid intervals, sometimes enjoying his senses and sometimes not, and that frequently depending up[illegible] of the moon" The common belief in [illegible] between the accessions of madness and the phases of the moon, from which the name is derived, has long since been exploded; and in medical science, the terms insanity and mental alienation have taken the place of lunacy; but in law it is still a common term, and is applied to all persons of unsound mind and incapable of managing their own affairs Some law writers prefer the phrase *non compos mentis* (Lat., not of sound mind), as a generic appellation to include the various conditions of mental disease, or fatuity, and the English equivalent, *of unsound mind*, is also sometimes employed; but lunacy is still the ordinary term, and may be fitly taken as the title under which to treat of the legal relations of insanity (which, physiologically, has been already treated under INSANITY). Formerly, a distinction was made between lunatics and idiots, which produced some important differences in the management of their property; but these having now fallen into disuse, the distinction is of little importance. An idiot was regarded as one who had no understanding from his infancy, and was therefore presumed by law as never likely to attain any, a lunatic, on the other hand, was one that had at one time been possessed of understanding, but by some means or other had lost it; and in his case, the presumption was that he might recover. In the case of the idiot, the custody of him and his lands was vested in the king, to prevent him from wasting his estate and reducing himself and his heirs to poverty and distress,—the king taking the profits, without waste or destruction, and fi[illegible] necessaries, and after his dea[illegible] to

his heirs. The crown had also the guardianship of lunatics, but acted only as trustee to protect their property, so as to account to them for all profits received, if they should recover, or after their decease to their representatives. Since the dissolution of the Court of Wards, the care and custody of idiots and lunatics have been intrusted to the lord chancellor. By act 16 & 17 Vict. c. 70, commonly called the Lunacy Regulation Act of 1853, most of the laws and regulations previously in force regarding lunatics have been consolidated. It authorizes the lord chancellor to appoint two serjeants or barristers at law, to be called masters in lunacy, to have and execute all the powers, duties, and authorities formerly had and executed by commissioners named in commissions of the nature of writs *de lunatico inquirendo*. The masters conduct their proceedings either separately or together, under the direction of the chancellor. The lord chancellor also appoints three visitors, two medical and one legal, to visit and report upon the condition of every lunatic under the care of the court. The method of proving a person insane is by a petition or information to the lord chancellor, who grants a commission in the nature of a writ *de lunatico inquirendo*, to inquire into the state of the person's mind, directed to the "masters in lunacy;" and if the lunatic be found *non compos*, the master usually commits the care of his person, with a suitable allowance for his maintenance, to some friend, who is then called his *committee*. The next heir, however, is seldom permitted to be the committee of the person of the lunatic, as it is his interest that he should die. The care of the estate is also committed to the same, or some other person, who is called the committee of the estate. By the Lunacy Regulation Act of 1862 (25 & 26 Vict. c. 86) it is enacted that in every inquiry or commission of lunacy, the question shall be confined to whether or not the person who is the subject of the inquiry is at the time of such inquiry of unsound mind, and incapable of managing himself or his affairs; and no evidence as to anything done or said by him beyond two years from the time of inquiry, shall be receivable. The lord chancellor is also empowered to direct land or other property of the lunatic to be sold, and applied for his maintenance, or that of his family, or for carrying on his trade or business. Lunatics are to be visited at least four times a year, and visitors are to report every six months to the lord chancellor. Persons of unsound mind may inherit or succeed to land, or personal property, but they cannot be executors or administrators, or make a will, or bind themselves by contract. Though conveyances of insane persons (except during a lucid interval) are, generally speaking, void, yet it is [illegible] that feoffments are not absolutely void, but voidable only, on account of the solemnity of livery with which they are accompanied; the chief practical difference between a void and a voidable transaction being that the former is a mere nullity, and therefore incapable of confirmation; but the latter may be either avoided or confirmed *ex post facto*. A person of unsound mind, though afterwards restored to reason, is not allowed to plead his past insanity in order to avoid his own act, it being a maxim in law, in regard to merely voidable transactions, that no man shall be allowed to stultify himself, or plead his own unsoundness of mind in a court of justice. But this maxim does not apply to transactions which are of themselves void. An insane person is competent to purchase, and also to retain what he purchases; but he cannot be compelled to retain it, the transaction (if found to be disadvantageous to him) being liable to subsequent voidance on account of his insanity. The marriage of a lunatic, except it be solemnized during a lucid interval, is absolutely void. As it might be difficult to prove the exact state of a person's mind at the celebration of marriage, it has been declared by statute (15 Geo. II. c. 30), that the marriage of persons found insane under a commission, or committed to the care of trustees by any act of parliament, before they are declared of sound mind by the lord chancellor, or the majority of such trustees, shall be totally void. In criminal cases, lunatics are not chargeable for their own acts, if committed when labouring under defect of understanding, not even for treason itself. By the common law, if a man in his sound memory commits a capital offence, and before arraignment for it becomes mad, he ought not to be arraigned for it, because he is not able to plead with that caution that he ought; if after he has pleaded he should become mad, he shall not be tried; for how can he make his defence? If after he be tried and found guilty, he loses his senses before judgment, judgment shall not be pronounced; and if after judgment he becomes of non-sane memory, execution shall be stayed; for, peradventure, says the humanity of the English law, he might have alleged something to stay judgment or execution. By statute 39 & 40 Geo. III. c. 94, it is enacted that if a person indicted for any offence appear insane, the court may (on his arraignment) order a jury to be impanelled to try his sanity, and if they find him insane, may order him to be kept in custody till the pleasure of the Crown be known; and if upon a trial for treason, murder, or felony, insanity at the time of committing the offence be given in evidence, and the jury acquit on that account, the court may order him to be kept in like manner till the Crown's pleasure be known. It is not, however, every kind or degree of insanity that will exempt a man from responsibility for his act, and in general, a partial insanity will form no excuse. But the entire law on this subject is in a painful state of uncertainty, and it is impossible to lay down any general rules as to what may be regarded as partial or perfect insanity, or what degree of insanity will exculpate a man from his acts. Generally speaking, however, if it is of such a nature as to render the person incapable of exercising self-control, he will not be held responsible.

Lunar Caustic, a term applied to nitrate of silver, cast in sticks, and used by surgeons for cauterizing purposes. A great improvement has been lately made in its manufacture by melting with it a certain proportion of chloride of silver, which has the effect of rendering the stick flexible instead of brittle.

Lunar Eclipse, *lu'-nar* (Lat. *luna*, the moon).— When the moon passes through the earth's shadow, a portion of the light which usually falls upon the surface of the former is intercepted, and the phenomenon is called a lunar eclipse. In the annexed diagram, SN



LUNAR ECLIPSE.

represents a section of the sun drawn through a great circle on its surface, and EH, a similar section of the earth's surface, both sections being considered to be in the same plane. To these sections let there be drawn the common tangents, NA, NB, SC, SD, which, on account of the great distance of the sun, may be supposed to intersect each other at S, N and E, H, the opposite extremities of two parallel diameters. The space EXH will, therefore, be a section of a cone, within the limits of which there is a total interception of the sun's light. When the moon passes into this darkened cone during her monthly revolution, it is evident that she will undergo an eclipse, which will be total or partial according as she passes wholly or partially into the shadow cast by the earth. The region represented in the diagram as AEX and DHX is called the penumbra, in which there is a partial interception of the solar light. The moon, if it revolved in the plane of the ecliptic, would pass through the shadow of the earth on each occasion that the earth came between her and the sun; consequently there would be an eclipse every month; but the lunar orbit is, in reality, inclined to the plane of the ecliptic at a mean angle of some-

what more than five degrees. Therefore a lunar eclipse can only occur when the moon is near either of the nodes of her orbit. By calculation, it has been found that when the distance of the node from the points of the ecliptic opposite to the sun exceeds 11° 25′ 40″, there can be no eclipse; but if the distance of the node from the same point is less than 9° 20′ 29″, there must be an eclipse. When there is a total lunar eclipse, that is, when the moon is completely enveloped in the earth's shadow, she is still visible, her surface appearing of a dull copper-colour, on account of the refraction of the light passing through the earth's atmosphere. The air has the property of [illegible] the violet rays of solar light: hence the [illegible] presented by the moon. In the course of a year there may be three lunar eclipses, which is the largest number that can happen, but there must always necessarily be two.

Lunar Evection, a term applied in Astron. to an inequality in the longitude of the moon, caused by the disturbing force of the sun. Its occurrence depends on the variable eccentricity of the lunar orbit and the movable position of the apsides. The discovery of lunar evection is attributed to Ptolemy, the celebrated astronomer of Alexandria.

Lunatic Asylums, *lu'-na-tik*.—It is one of the marks of the civilization of the present age—the care that is now taken of lunatics. In some parts they are excluded from human society, inhabiting graveyards or ruinous places. Formerly, in England, harmless lunatics, while allowed to wander about the country, were subjected to much hardship and ill-usage, while those that were less tractable were confined in asylums and treated like wild beasts. Mackenzie, in his "Man of Feeling," published in 1771, has described a visit to the old hospital of Bethlehem, in Moorfields, London. Here they were made a show of, like wild beasts, and were even excited to rage, in order to make the exhibition more stimulating. "The clanking of chains, the wildness of their cries, and the imprecations which some of them uttered, formed a scene inexpressibly shocking." "I think it," says Harley, "an inhuman practice to expose the greatest misery with which our nature is afflicted to every idle visitant who can afford a trifling perquisite to the keeper." The first attempt to introduce a milder system of treatment of the insane was made by M. Pinel, at the hospital of Bicêtre, near Paris, in 1792; but notwithstanding the success of this attempt, the practice was long in being introduced in England. The evidence brought before the parliamentary committees in 1815 shows that every species of cruelty was practised against this unfortunate portion of the human race. The keepers w[illegible] lowest and most brutal character, and the severest restraint and most cruel neglect seem to have been the almost uniform practice. From this time improve[illegible] to gradually introduced in the treatment of the [illegible] straints of much milder kinds substituted, more care was given to the warming and clothing of the patients, and the furnishing them with [illegible] introduced. The credit of declaring [illegible] of all mechanical instruments of restraint to be practicable belongs to Mr. Hill, of the Lincoln asylum, and was adopted there in 1837, and is now followed in all the more important asylums of the kingdom. Act 14 Geo. III. c. 49, introduced the system of licensing lunatic asylums and subjecting them to inspection, and 48 Geo. III. c. 96, made various provisions for the better care and maintenance of lunatics, for the building and endowment of asylums, &c. These and various othe[illegible] by enactments, particularly by 16 & 17 Vict. c. 97, called "the Lunatic Asylum Act, 1853." It enacts that the justices of every county and of every borough not having an asylum for the pauper lunatics thereof, shall take measures to provide one for the same, either separately or in union with one or more counties or boroughs, or with the subscribers to some asylum [illegible] by voluntary subscription, and the expenses of such institutions, so far as they are not covered by voluntary contributions, to be defrayed by the county or borough rates, and the management to be vested in a committee of visitors, to be elected yearly by the justices of the county or borough, or partly by the justices and partly by the subscribers. Two visitors, at least, are to visit every lunatic asylum of which they are visitors, at least once every two months, and annual reports are to be made by committees of visitors to justices at quarter-sessions, &c., and copies to be sent to commissioners in lunacy. Provision is made for having any pauper resident in a parish, and who is deemed to be a lunatic, examined before a justice and a medical officer, and if found to be insane, committed to the asylum. In like manner, [illegible] insane persons (whether paupers or not) found wandering at large in the county or borough, or not under proper care or control, may be sent to the asylum. It [illegible] further enacted that no person, not being a pauper, can be received as insane into an asylum except under a written order of some person by whose direction the lunatic is confined, accompanied by a medical certificate of two physicians or surgeons, who shall have visited him separately and have no interest in the asylum in which he [illegible] confined. By 8 & 9 Vict. c. 100, a board of commissioners is appointed, comprising three physicians and three barristers, with salaries, and five others who act gratuitously. They have the general superintendence and control of all lunatic asylums. Every house for the reception of lunatics must be duly licensed either by the commissioners of lunacy, if in London or the neighbourhood, or, if in the country, by the magistrates at quarter sessions. No additions to, or alterations in, a licensed house can be made without the consent of the commissioners, and no license is to remain in force more than thirteen months. Houses having a hundred [illegible] more patients are required to have a resident medical attendant, those having fewer to be [illegible] sited by a medical attendant at defined periods, according to their size. Act 25 & 26 Vict. c. 111 (1862), has a number of minute provisions regarding the construction and plans of asylums, the inspection of licensed houses, providing superannuation allowances for officers of asylums, the admission and visitation of pauper lunatics, &c. According to the Fifteenth Report of the Commissioners in Lunacy, there were, at 1st January, 1861, in all, 21,834 lunatics in asylums in England and Wales; 16,718 being pauper, and 5,116 private patients; 11,673 being male, and 10,161 female. Of these, 18,587 were in county and borough asylums, 2,114 in hospitals, 1,953 in metropolitan licensed houses, and 2,150 in provincial licensed houses. The total number admitted during the previous year was 9,210, the number discharged as recovered, 2,905; the number of deaths, 2,719. The law on the subject of lunacy in Scotland is [illegible] consolidated in 20 & 21 Vict. c. 71, as amended by 21 & 22 Vict. c. 89. The total number of insane in [illegible] at 8,044, being 3,922 males and 4,162 females, 2,858 private and 5,226 pauper patients, 2,632 were in public and 852 in private asylums, 866 were in poorhouses and 3,734 in private houses. In Ireland, the number of [illegible] the asylums, gaols, or workhouses, on April 1, 1861, is given at 8,991, being 4,959 males and 4,032 females; [illegible] males and 1,769 females, [illegible] was 4,289, being 2,165 [illegible]; the number in gaol, 293, being 184 males and 109 females. The total number of lunatics, idiots, and epileptics in Ireland on 1st April, 1861, was thus 16,107, of whom 8,273 were males and 7,834 females. Ireland thus presents the anomaly of having more insane males than females.—Ref. *The English Cyclopædia*.—Arts and Sciences, various Parliamentary Reports; and the Acts of Parliament referred to.

Lunette, *lu-net'* (Fr.), a term applied rather vaguely in Fortification to a work somewhat similar to a ravelin or demi-lune, but generally of smaller dimensions. It is probable that in its original signification the word comprised every detached work built in the form of an angle, and consisting of only two faces. It was afterwards used in a more restricted sense, to denote small advanced works placed before the ravelin or other outworks, for the purpose of covering such places of the chief rampart as might be [illegible] original plan of the fortification. The best disposition for a series of lunettes is that in which they are alter-

nately more or less advanced from the fortress, since in that position they afford one another a reciprocal defence by the crossing fires which may be kept up from the nearest faces of every salient and retired lunette. In case the besiegers should carry their approaches up the glacis of the latter, the guns on the flanks of the two salient lunettes on either side would effectually prevent them from forming a battery on its crest; consequently, the [illegible] retired lunette must be postponed till the [illegible] teral lunettes are taken. If all had been equally advanced before the fortress, the three might have been breached and assaulted at the same time. Advanced lunettes about a fortress form strong posts for artillery, and tend to check the [illegible] considerable time, by obliging him to [illegible] at a greater distance than he would otherwise have done, and subjecting him to losses in the capture of each lunette. The faces of such works may be from sixty to seventy yards, and that of their flanks from sixteen to twenty. It is considered that a well-disposed series of lunettes would prolong the defence of a place about ten or twelve days. They can only be employed, however, for fortresses of the first magnitude, since they would require a large garrison.

Lunge, Longe, or Allonge, *lunge* (Fr.), in Fencing, is the third mode of attack, and is executed by first making the movement termed the "extension," and afterwards advancing the right forward, as far as can be done with ease, towards the opponent. The right foot is firmly planted on the ground, the body quite erect, resting equally upon both legs, the height of the shoulders equal, the right thigh nearly horizontal with the ground, and the leg perpendicular. The thrust of the weapon proceeds from the wrist, the point of the foil being elevated, and advanced towards the breast of the adversary.

Lungs, *lungs* (Sax. *lungen*), in Anat., are two large conical bodies placed one in each of the lateral cavities of the chest, and separated from each other by the heart and large vessels and by two layers of the pleura, which form the mediastinum, or median partition. They occupy by far the larger portion of the cavity of the chest, and [illegible] accurately adapt themselves [illegible] Each lung is invested by an [illegible] membrane, termed the pleura. Each pleura forms an independent shut sac quite distinct from the other, inclosing the corresponding lung as far as its root, and then reflected back upon the inner surface of the thorax. The portion investing the surface of the lung is called the *pleura pulmonalis*, while that which lines the inner surface of the chest is called the *pleura costalis*. The root is that part of the lung which is connected to the heart and the trachea, being formed by the bronchial tube, the pulmonary artery and veins, the bronchial arteries and veins, &c., all of which are inclosed by a reflection of the pleura. Each lung is of a conical shape, with a broad concave base resting upon the convex surface of the diaphragm. The apex forms a blunted point, which extends into the root of the neck about an inch above the level of the first rib. The outer or thoracic surface is smooth, convex, and of considerable extent, corresponding to the form of the cavity of the chest, and of greater depth behind than in front. The inner surface is flattened or concave, presenting in front a depression corresponding to the convex surface of the pericardium, and behind a deep fissure (the *hilum pulmonis*) which gives attachment to the root of the lung. The posterior border is obtuse or rounded, and is received into the deep groove formed by the ribs at the side of the vertebral column. The anterior border is thin and sharp, and overlaps the front of the pericardium. The anterior portion of the right lung corresponds to the median line of the sternum, and is in contact with its fellow, the pleuræ being interposed, as low as the fourth costal cartilage, below which they are separated by a [illegible] interval formed at the expense of the [illegible] Each lung is divided into two lobes, a lower and an upper, by a long and deep fissure, which commences upon the upper portion of the posterior border of the lung, about three inches from the apex, and extends obliquely downwards and forwards to the lower part of the anterior border, penetrating nearly to the root of the organ. The upper lobe is smaller than the lower, and is conical, with an oblique base, while the lower lobe is more or less quadrilateral. In the right lung, the upper lobe is partially divided by a second and shorter fissure, extending from the middle of the principal fissure forwards and upwards to the anterior margin of the organ, and marking off a small triangular portion, called the middle lobe. The right lung has thus three lobes, and is larger and broader than the left. The weight of the lungs varies much, according to the quantity of blood, mucus, or serous fluid that they may contain; but in general they are found to be between 36 and 42 ounces,—the right lung being about two ounces heavier than the left. The lungs are heavier in the male than in the female, [illegible] the former in proportion to the body as 1 to [illegible] in the latter as 1 to 43. The substance of the lung is of a light, porous, spongy texture, and when healthy, is buoyant in water; but in the fœtus, before respiration has taken place, and also in cases of congestion or consolidation from disease, the entire lungs, or portions of them, will sink in that fluid. The specific gravity of a healthy lung after death varies from 345 to 746, water being 1,000. At birth the lungs are of a pinkish-white colour, but as life advances they become darker, and are mottled or variegated with patches of a dark slate-colour, assuming at length a dark black colour. The pulmonary tissue is endowed with great elasticity, in consequence of which the lungs collapse by atmospheric pressure, when the thorax is opened, to about one-third of their bulk. The lungs are composed of an external [illegible] coat, a subserous [illegible] areolar tissue, and the pulmonary substance. The serous coat is derived from the pleura, as already mentioned, beneath which is a thin layer of subserous areolar membrane, containing a large proportion of elastic fibres. It invests the entire surface of the [illegible] between the lobules. The [illegible] is composed of numerous small lobules, which, although closely connected together by an interlobular areolar tissue, are quite distinct from one another, and are easily separable in the fœtus. These lobules are of various sizes, those on the surface being large and of a pyramidal form, with the base turned towards the surface; those in the interior being smaller, and of various forms. Each lobule may be regarded as a lung in miniature, the same elements entering into its composition as go to form the lung itself. Each is composed of one of the ramifications of the bronchial tube and its terminal air-cells, of the ramifications of the pulmonary and bronchial vessels, lymphatics and nerves, all being connected together by areolar fibrous tissue. Each bronchus, on entering the substance of the lung, divides and subdivides dichotomously throughout the entire organ. Sometimes three branches arise together; and occasionally small lateral branches are given off from the sides of a main trunk. Each of the smaller divisions of the bronchi enters a pulmonary lobule, and again subdividing, ultimately terminates in the intercellular passages and air-cells, of which the lobule is composed. After entering the substance of the lobules, each lobular bronchial tube is said to divide and subdivide from four to nine times, according to the size of the lobule, diminishing in size until they attain a diameter of $\frac{1}{50}$ to $\frac{1}{30}$ of an inch, when they become changed in structure, lose their cylindrical form, and are continued onwards as irregular intercellular passages through the substance of the lobule. Within the lungs, the bronchial tubes are not flattened behind like the bronchi and trachea without, but form completely circular tubes. The air-cells are small polyhedral alveolar recesses, separated from each other by thin septa, and communicating freely with the intercellular passages. They vary from $\frac{1}{200}$ to $\frac{1}{70}$ of an inch in diameter, and are larger on the surface than in the interior. The pulmonary artery conveys the venous blood to the lungs. It divides and subdivides into branches, which accompany the bronchial tubes, and terminates in a dense capillary network upon the walls of the intercellular passages and nerves. From this network, the radicles of the pulmonary veins arise, and, coalescing into large branches, at length accompany the arteries and return the blood, purified by its passage, through the capillaries to the heart. In their course through the lung, the branches of the pulmonary artery are usually

found above and in front of a bronchial tube, and the vein below. The pulmonary arteries and veins differ from the same vessels in other parts of the body, inasmuch as the former convey dark blood, the latter red blood. The pulmonary veins are also destitute of valves. The bronchial arteries and veins are much smaller than the pulmonary vessels, and are designed for the nourishment of the substance of the lungs. The lungs are supplied with nerves from the pulmonary plexuses, formed chiefly by the par vagum, together with filaments from the sympathetic. The absorbents are deep seated and superficial. They pass to the bronchial glands at the roots of the lungs, and then proceed partly to the thoracic duct on the left side and partly to a corresponding vessel on the right. The lungs are the great organs of respiration. The air passes through the bronchial tubes until it reaches the minute air cells, on the walls of which the blood circulates in a network of capillaries in such a way that it is brought into immediate connection with the atmospheric air, which is drawn in by each inspiration. In the act of breathing, the capacity of the chest is increased by the action of certain muscles, when the air rushes in to fill the vacuum, and expansion of the lungs takes place, and then, the muscular movement ceasing, the ribs by their weight and elasticity contract and force out the air. From fifteen to twenty-two is the average number of respirations in a minute, but this number may be very greatly increased by excitement, exercise, or disease. The lobules are not all distended with air in ordinary inspiration, nor by the most powerful efforts that can be made. Those of the upper parts of the lungs seem to be most filled, and are most constantly in action. The average quantity of air contained in the lungs is estimated at about 2[illegible] cubic inches. In each ordinary act of inspiration, or expiration, a change of from 20 to 30 cubic inches is supposed to take place. The lungs, from their highly-org[illegible] structure and their incessant exercise, are perhaps more liable to disease than any other part of the bod[illegible]

their first stages at least, of an inflammatory character, and are mostly produced by exposure to damp and cold, sudden atmospheric changes and transitions of [illegible] prop[illegible] state of the lungs can now be ascertained with tolerable certainty by means of auscultation (which see). For part[illegible] of the lungs, *see* ASTHMA, BRONCHITIS, HÆMOPTYSIS, PLEURITIS, PNEUMONIA, PHTHISIS.—*Ref.* Quain's *Anatomy*, by Sharpey; Gray's *Anatomy*.

LUNG-WORT. (*See* STICTA.)

LUPUS, *lu'-pus* (Lat. *lupus*, the wolf), a constellation of the southern hemisphere, which originally formed part of the constellation Cent[illegible] to Aratus and Ptolemy. It lies to [illegible], having Centaurus on one side of it and Ara on the other. Its largest star is one of the third magnitude.

LUPUS (Lat., a wolf), in Path., is a name given to a malignant disease of the face, which eats away the parts attacked with great rapidity; and hence its comparison to a wolf.

LURCHER, *lur'-tsher*, a sort of hunting-dog, resembling a [illegible] a shaggy coat, and [illegible]. It runs very swiftly, [illegible] rows and the rabbits, it seldom misses taking them; in hunting, this is its usual practice. The lurcher is much used by poachers.

LUSIAD, *lu'-se-ad*, is the name given to the great epic poem of Portugal, written by Camoens, and published in 1571. As the Italians boast of Tasso, so do the Portuguese of Camoens, and, indeed, the two poets were contemporary, but the Lusiad appeared before the Jerusalem. The subject of the Lusiad is the first discovery of the East Indies by Vasco de Gama, an enterprise splendid in its nature and extremely interesting to the author's countrymen, as it laid the foundation of their future wealth and consideration in Europe. The poem opens with Vasco and his fleet appearing on the ocean, between the island of Madagascar and the coast of Ethiopia. After various attempts to land on that coast, they are at length hospitably received in the kingdom of Melinda. Vasco, at the desire of the king, gives him an account of Europe, recites a poetical history of Portugal, and relates all the adventures of the voyage which had preceded the opening of the poem. This recital takes up three cantos or books. It is well imagined, and contains a great many poetical beauties, its only defect being an unreasonable display of learning to the African prince in frequent allusions to the Greek and Roman histories. Vasco and his companions afterwards set forth to pursue their voyage. The storms and distresses which they encounter; their arrival at Calicut, on the Malabar coast; their reception and adventures in that country, and at last their return homewards, fill up the rest of the poem. Both the subject and the incidents of the Lusiad are magnificent, and, joined with some wildness and [illegible], there appear in the execution much poetic spirit, strong fancy, and bold description; but the machinery of the poem is perfectly extravagant. It [illegible] mixture of Christian ideas and [illegible], and is so conducted that the pagan gods appear to occupy the chief place. The great protector of the Portuguese is Venus, and their great adversary Bacchus, whose displeasure is excited by Vasco's attempting to rival his fame in the Indies. It contains, however, some fine machinery of another description; as, for instance, when the genius of the river Ganges is made to appear to Emanuel, king of Portugal, in a dream, [illegible] him to discover its secret springs, and [illegible] him that he was the monarch for whom [illegible] of the East were reserved; and when the huge and monstrous phantom appeared to them, rising out of the sea, at the Cape of [illegible] Hope, which had never been doubled by navigator before, [illegible] them for daring to explore these seas, [illegible] the successive calamities that [illegible] to befall [illegible]. The p[illegible] be[illegible]quently translated into foreign tongues. There are two English translations, one by Fanshaw, the other by Mickle.

LUSTRUM, *lus'-trum* (probably from Lat. *luere*, to wash or expiate).—Among the Romans, this name was given to each successive period of five solar years, at the close of which a census of the people was taken, which was followed by a solemn expiatory sacrifice of a sow, a sheep, and a bull. The sacrifice was made under the direction of the censor, and the animals were slain in the Campus Martius, or Field of Mars, near Rome, after having been led three times round the people that had assembled there to witness the [illegible]. It was afterwards used to denote any period of five years, a man who had commenced his 36th year being said to have completed his seventh lustrum, and to have entered on the eighth. After the establishment of the Julian calendar, and the adoption of the solar year of 365 days, the old Roman year of 304 days was still retained for religious purposes; and Niebuhr considers the lustrum to mean the periods of time at the conclusion of which the commencement of the Roman civil and religious years again coincided; six religious years of 304 days being just equal to five civil or solar years of 365 days.

LUTE, *lute*, a term probably derived from the Teutonic *lut* (whence, modified, it has passed into most European languages), employed to designate an ancient musical instrument of the guitar kind, somewhat resembling in shape the section of a pear, and consisting of four parts, viz., the table; the body, which has nine or ten sides; the neck, containing as many stops or divisions; and the head or cross, in which the screws are inserted. It is played upon by striking the strings with the fingers of the right hand, and regulating the sounds with those of the left. Its origin is unknown, but generally believed to have been very ancient. It was, in all probability, derived from the ancient lyre. Vincentio Galilei ascribes its invention to the English, among whom, according to Burney, the first author who mentions it is Chaucer. Until the end of the 17th century, a knowledge of this instrument was considered an almost indispensable part of a good education; after that time, however, it became gradually superseded by the guitar. It is said to have gone out of fashion from its being considered to occasion deformity in ladies.

LUTE (Lat. *lutum*, clay), a soft adhesive mixture, principally earthy, used either for closing apertures at the junction of different pieces of apparatus, or for

coating the exterior of vessels which are to be subjected to a high temperature, in order to strengthen them and prevent their fracture. Lutes for the purpose of making the junction of apparatus tight are numerous, in consequence of the variety of vapours which require to be confined, and the difference of temperature to which they are subjected. The principal lutes are,—Stourbridge clay, in fine powder, which sustains a higher heat than any other English lute; Windsor loam, obtained at Hampstead, a natural mixture of clay and sand; Wills's lute for making earthenware retorts impervious to air or vapours,—it is composed of borax and slaked lime, Fat lute, prepared by beating dried and finely-pulverized clay with drying linseed-oil. Plaster of Paris, mixed with water or a thin solution of glue, makes a hard stony cement, but it will not support a very high temperature. Iron cement is used for making permanent joints, generally between surfaces of iron it consists of clean iron borings or turnings, slightly pounded, sifted coarsely, and then mixed up with powdered sal-ammo[illegible] sulphur, with enough water to moisten the whole slightly. Several other lutes are employed, which vary according to the objects for which they are designed

LUTHERANISM, *lu'-ther-ăn-izm*, is the name given to that system of Protestantism adopted by the followers of Luther The Lutheran church professes no other rule of faith than the Holy Scriptures. The Confession of Augsburg (*see* AUGSBURG CONFESSION), with Melancthon's defence of it, the Articles of Smalcald the larger and smaller Catechisms of Luther, and the Formula Concordiæ, are generally [illegible] containing the principal points of doctrine, [illegible] the books have no authority but what they d[illegible] the [illegible] reduced the number of [illegible] [illegible] and the Lord's Supper; but [illegible] tained the doctrine of impanation (which *see*) or consubstantiation, which forms the main difference between the Lutheran and English churches [illegible] maintained the mass to be no sacrifice opposed the adoration of the host, auricular confession, monastic vows, indulgences, purgatory, meritorious works, the worship of images, celibacy of the clergy, &c There are, h[illegible] [illegible] the Romish church which [illegible] Lutherans as tolerable, and some of them [illegible] distinguishing vestments of the clergy, the us[illegible] in the administration of the eucharist, t[illegible] exorcism in the celebration of baptism, [illegible] confession of sins, the use of images, of [illegible] lighted tapers in their churches, [illegible] upon the altar Some of these, howev[illegible] general, but confined to particular [illegible] Lutheranism is regarded as more nearly a[illegible] to [illegible] than any other reformed system Some of th[illegible] doctrines which were warmly [illegible] by Luther [illegible] now generally aband[illegible] by his followers, as, for instance, the doctrines of absolute predestination, human impotence, and [illegible] grace, which are so distinct from Lutheranism now, that they are generally known as Calvinistic doctrines The Lutherans now maintain, with regard to the Divine decrees, that they respect the salvation or misery of men in consequence of a previous knowledge of their sentiments and characters, and not as free and unconditional, and as founded on the mere will of God. Towards the close of the 17th century, the Lutherans began to entertain a greater liberality of sentiment than they had before adopted; and their teachers now enjoy an unbounded liberty of dissenting from the decisions of those symbols or creeds which were once deemed almost infallible rules of faith and practice, and of declaring their dissent in the manner they deem most expedient. The constitution of the church is simple, and in every country where it is established, the head of the state is acknowledged as the supreme visible ruler of the church. It is governed by a consistory composed of divines and civilians, frequently appointed by the sovereign himself. The German Lutherans reject episcopacy; but as the Reformation extended, and Sweden and Denmark embraced the Lutheran faith, these countries retained the episcopal form of government, and are governed by bishops and superintendents under the authority of the sovereign. The forms of worship vary in different countries. Every country where Lutheranism prevails has its own liturgy, which is the rule of proceeding in all that relates to external worship and the public exercise of religion. The liturgies used in the different countries agree in all the essential branches of religion, but differ widely on matters of an indifferent nature regarding which Scripture is silent. Festivals in commemoration of the great events of gospel history were once observed, as well as a few saints' days; but these are now suffered to pass almost unnoticed. Ecclesiastical discipline is almost unknown; and religion itself has long, it must be confessed, been at a low ebb in most of the Lutheran churches. Lutheranism has been for centuries a state machine, from which little was expected, and by which little has been done. It has never grappled with the warm affections of an ardent people, or subdued and governed the intelligence of a thoughtful r[illegible] Its career has been monotonous and [illegible] When its children have been awakened to a due sense of the importance of religion, they have forsaken its [illegible] To the Lutheran church, however, be[illegible] the honour of having been the first of Protestant communities in the missionary field At present Lutheranism is most powerful in Denmark and Sweden. In the Protestant states of Germany and in Holland the Lutheran is, upon the whole, the prevailing faith, though the proportion of Roman Catholics is often great In France, Russia, Poland, Hungary, there are also a number of Lutheran churches. The number of members of the Lutheran church throughout the world is estimated at 30,000,000. [illegible] attempts have been made to unite the Lutherans [illegible] Calvinists, but with little success A sort of me[illegible]al union of the two churches was effected in [illegible] in 1817, on the basis of a declaration promul[illegible] by a synod convened by royal authority at [illegible] The united church forms what is known as the evangelical church of Prussia, a church in which the Lutheran is not compelled to embrace Calvinism, [illegible] the Calvinist Lutheranism The two confessions thus held within the pale of the same church, and [illegible] unfrequently preached by colleague ministers [illegible] walls The differences between the [illegible] ch[illegible] [illegible] [illegible]nted insuperable obstacles to an efficient union [illegible] return to the primitive sources of [illegible] Luth[illegible] little else than a new [illegible] of L[illegible] Chr[illegible] [illegible]ized from Scripture alone, Lutheranism accorded to tradition a regulative power

LUXATION, *luks-a'-shun* (Lat *luxatio*, from *luxo*, I put out of joint), in Surg, is the dislocation of a bone from its proper cavity. (*See* DISLOCATION)

LUXURY, *luks'-u-re* (Lat *luxuria*), in Pol Econ, is a word of very indefinite signification, and may be taken in a good or a bad sense. "In general," says Hume, "it means great refinement in the gratification of the senses, and any degree of it may be innocent or blameable, according to the age, or country, or condition of the person" The gratification of any of the senses is not of itself a vice, and only becomes so when pursued at the expense of some virtue. "Luxury," says Dr Clarke, "does not consist in the innocent enjoyment of any of the good things which God has created to be received with thankfulness, but in the wasteful abuse of them to vicious purposes, in ways i[illegible] with sobriety, justice, or charity." Mo[illegible] [illegible] to [illegible] most innocent luxury, and to represent it as the source of all the corruptions, disorders, and factions incident [illegible] government. In particular the ancient moralists regarded the luxury of the rich, or their more refined mode of living, as an evil of the first magnitude. They considered it as subversive of those warlike virtues which they principally admired, and consequently denounced it as fraught with the most injurious consequences "But it would be easy to prove," says Hume, "that these writers ascribed to luxury and the arts what really proceeded from an ill-modelled government and the unlimited extent of conquests. Refinement on the pleasures and conveniences of life has no natural tendency to beget venality and corruption." On the contrary, he maintains "that the ages of refinement are both the happiest and most virtuous; and that wherever luxury ceases to be innocent, it also

ceases to be beneficial; and when carried a degree too [illegible] excessive is the source of many ills; but is in general preferable to sloth and idleness, which would commonly succeed in its place, and are more pernicious both to private persons and to the public." What are to be regarded as necessaries or luxuries to an individual, depend partly upon the habits in which the individual has been brought up, partly on the nature of his occupation, and partly on the climate in which he lives. The same style of living which would be reckoned moderate, or even penurious, among the higher orders, would be censured as extravagant luxuries in a day-labourer; while the cottage and [illegible] of the labourer would be thought luxuries to an [illegible] prince. In this country there formerly existed a number of penal statutes against luxury. Excess in apparel was legislated against, chiefly in the reigns of Edward III., Edward IV., and Henry VIII., all of which were repealed by 1 Jac. I. c 25. As to excess in diet, 10 Edward III stat. 3, ordained that no man should be served at dinner or supper with more than two courses, except upon some great holidays there specified, in which he might be served with three. This last statute was only expressly repealed by 19 & 20 Vict. c. 64.

Lycanthropy, *li-kan'-thro-pe* (Gr. *lukos*, a wolf, and *anthropos*, a man), is defined by Cotgrave to be "a frenzie or melancholie which causeth the patient (who thinks he is turned woolf) to flee all company and hide himself in dens and corners." Herodotus says that, according to the Scythians, every Neurian once a year changes himself for some days into a wolf, and afterwards resumes his own shape; but adds, "they cannot make me believe such stories, though they not only tell them, but swear to them." A similar superstition is noticed by Virgil in [illegible], Pliny, Pausanias, and other writers. [illegible] lycanthropy appears to have been extremely prevalent in the 16th century, and numerous authentic [illegible] remain to us of victims committed to [illegible] for this practice, for the most part in consequence of their own confessions. They were called *loups-garous* by the French, *were-wolves* by the Anglo-Saxons, *wehr-wolfe* by the Germans, and were believed to be extremely ferocious, devouring not only beasts, but human beings. From the prevalence of this superstition, many persons were led to believe themselves wolves, and to imitate the howl and actions of these animals; a species of insanity to which the term lycanthropy was also applied. It was said to manifest itself "by the patient's going out of doors at night and imitating the actions of wolves, and in the daytime wandering in burial-grounds." (See a learned article on this subject in the *[illegible] Metropolitana*.)

Lyceum, *li-se'-um*, [illegible] of an academy at Athens, so called from its position near the temple of Apollo Lyceus. Here Aristotle and his disciples taught, and were called Peripatetics, from their habit of walking up and down its porches while delivering their lectures. In the present day, on the continent, the name is given to preparatory schools for the universities, as in them the Aristotelian philosophy was formerly taught.

Lycoperdon, *li-ko-per'-don* (Gr. *lukos*, wolf; *perdomai*, I break wind, because supposed to spring from wolf's dung), in Bot., the Puff-ball, a gen. of *Fungi*. When the species *L. giganteum* is submitted to combustion, fumes arise which are powerfully narcotic. In this way the fungus has been employed to stupefy bees when removing honey from the hive. Lately, the vapour has been proposed as an anæsthetic agent instead of chloroform.

Lycopersicon, *li-ko-per'-si-kon*, in Bot., a gen. of the nat. ord. *Polemoniaceæ*. The species *L. esculentum* produces the juicy acid fruits [illegible] *apples*, or *tomatoes*, much employed in the [illegible]

Lycopodiaceæ, *li-ko-po-de-a'-se-e* (Gr. *lukos*, wolf; *pous*, foot), in Bot., the Club-moss fam., a nat. ord. of *Acotyledones*, sub-class *Acrogens*. Herbaceous plants, usually resembling mosses, with creeping stems and forked ramification; or aquatic plants, with corn-like stems. The order includes six genera and about 200 species, which occur in cold, temperate, and warm climates.

Lycopodium, *li-ko-po'-de-um*, in Bot., the typical gen. of the nat. ord. *Lycopodiaceæ*. The species *L. clavatum* is the common club-moss, an inconspicuous plant found on heaths. Pharmacologists state that it possesses well-marked emetic and purgative properties. The spores have been employed externally for their absorbent qualities in erysipelas and various cutaneous affections. They are of a yellow colour, and are sometimes styled *vegetable sulphur*. They are commonly employed in pharmacy for covering pills, the object sought being to render the pills tasteless, and to prevent their adhering together. The spores are highly inflammable, and are much used in the preparation of fireworks, and in the production of [illegible] at the theatres.

Lymph, *limf* (Lat. *lympha*, water), in Anat., is a thin, transparent, colourless fluid, which is found in the lymphatic or absorbent vessels abundantly distributed over the body. (*See* Lymphatics.) Its taste is saline, and it has a faint, scarcely perceptible smell. When examined with the microscope, it is seen to consist of a clear liquid, with corpuscles floating in it, which agree entirely with the pale corpuscles of the blood. The liquid part bears a strong resemblance in its physical and chemical constitution to the plasma of the blood. The constituent parts of lymph are as [illegible]

Water	96·926
Fibrin	·520
Albumen	·434
Ozmazome	·312
Fatty matters	·264
Salts	1·544
	100·

Lymph is a nutritious fluid, and not excrementitious, as was maintained by Hewson and Hunter.

Lymphatics, *lim-fat'-iks*, in Anat., is the name given to a class of vessels in the human body, from their [illegible] lymph. They are also called absorbents, [illegible] property they possess of absorbing certain materials for the replenishing of the blood, and conveying them into the circulation. The lymphatics are found in all animals which have a lacteal system, the two forming one set of vessels; and, indeed, under the head of lymphatics, in works on anatomy, are generally included the lacteals. The lacteals differ from the lymphatics proper only in containing a milk-like fluid,—the chyle, which they take up in the intestines during [illegible] process of digestion, and convey into the blood through the thoracic duct. The lymphatics are ex[illegible]ingly delicate vessels, their coats being so transparent that their fluid contents are readily seen through them. They are found in nearly all the textures and organs of the body which receive blood, with the exception of the substance of the brain and spinal cord. In the different regions of the body, and in the several internal viscera, they are arranged into a superficial and a deep set,—the former running immediately beneath the skin, or under the membranous coats enveloping organs internal; the latter usually accom[illegible] deep-seated blood-vessels. The origin of [illegible] may be either superficial or deep, and [illegible] commonly is in the form of networks or plexuses, out of which single vessels emerge at various points, and proceed directly to lymphatic glands, or to join larger lymphatic trunks. The fluids imbibed by these plexuses must pass into them by transudation. The lymphatics of any part or organ exceed in number the veins, but in size they are much smaller. They are interrupted at intervals by constrictions, which give to them a knotted or beaded appearance; and these constrictions correspond to the presence of valves in their interior. Like the veins and arteries, the lymphatics are composed of three coats,—an internal, middle, and external. The lymphatic, or absorbent glands, named also conglobate glands, are small solid bodies, situated in the course of the lymphatic and lacteal vessels, and through which their contents pass in their course towards their union with the blood. A lymphatic vessel may pass through two, three, or more of these bodies in its course, while, on the other hand, there are some which reach the thoracic duct without encountering any. Their size is very various, some

being not much bigger than a hemp-seed, others as large or larger than a kidney-bean. They are collected in numbers along the course of the great vessels of the neck, also in the thorax and abdomen, especially in the mesentery and alongside the aorta, vena cava inferior, and iliac vessels; also in the axilla and groin, and on the popliteal vessels. A lymphatic or lacteal, previous to entering a gland, divides into several small branches, which are named afferent vessels. As they enter, their external coat becomes continuous with the capsule of the gland, and the vessels, much thinned, divide and subdivide while pursuing a tortuous course, and, finally anastomosing, form a plexus The vessels composing this plexus unite to form two or more efferent vessels, which, on emerging from the gland, are again invested with their external coat. Capillary vessels are abundantly distributed on the walls of the lymphatics in the glands. The absorbent system discharges its contents into the veins at two points,—namely, at the junction of the subclavian and internal jugular veins of the left side by the thoracic duct, and in the corresponding part of the veins of the right side by the right lymphatic trunk. The openings are guarded by valves.—*Ref.* Quain's *Anatomy*, by Sharpey and Ellis

LYNCH LAW, *linsh*, is a term applied to the administration of justice at the hands of the populace, which is not uncommon in certain parts of the United States of America. This barbarous system is said to be owing to the imperfect provision made for the due administration of justice, and the difficulty of enforcing the law against offenders, and is said to take its name from one Lynch, a Virginian farmer, who had recourse to this mode of punishing an offender. In such cases, the offender is seized by the populace, or the person against whom he has offended, is summarily tried and sentenced, and the sentence at once carried into execution, being usually to be flogged or put to death In many other countries, where civilization is not far advanced and the laws little observed, a species of lynch law will be found to prevail. It is, however, a most iniquitous and brutalizing system, and is the usurping, with unhallowed hands, the most sacred of trusts committed to a state.

LYNX, *links* (Lat.), a general name applied to the short-tailed *Felidæ*. Under this head several species were formerly confounded by Linnæus, and at the present day there is still much confusion with respect to them. *Felis cervaria*, the largest and most beautiful, is found in Asia and Europe. *Felis lynx*, the European lynx, has become rare, and is only found in the Pyrenees and part of the Apennines. In length this animal is about three feet, and is very destructive to the smaller quadrupeds Among the ancients it was celebrated as having been harnessed to the car of Bacchus when he made his Indian conquest Great quickness of sight was also attributed to it, and it was supposed that its urine was converted into a precious stone. The skin of the male is spotted, and is more valuable in winter than in summer. Another species of lynx is the caracal, which is slightly larger than a fox It derives its name from the black colour of its ears, *caracal* being a Turkish word signifying black In North America there are several species of these animals, the best known of which is the northern or Canada lynx, distinguished by the name of *loup-cervier* and *le chat* among the French Canadians. In the region round Hudson's Bay it is found in great abundance, about seven to nine thousand skins being annually exported Although a timid creature, and incapable of attacking the larger quadrupeds, it is very destructive to rabbits and hares, on which it chiefly preys When brought to bay by a hunter, it makes but a slight resistance, for, though it spits and erects the hair on its back like a cat, it is easily killed by a blow with a slight stick. In appearance it is clumsy and awkward, on account of its large paws, slender loins, and long but thick hind legs, with large buttocks, scarcely relieved by a short thick tail. It moves in straightforward bounds, with the back a little arched, and lighting on all four feet at once. It is not swift on land, but swims well. Its flesh is eaten, and somewhat resembles the rabbit in flavour. It breeds once a year, and has two young ones at a time. There are two other American species, both of which are smaller than the preceding; they are named respectively *Felis rufa* and *Felis fasciata*.

LYNX, a constellation of the northern hemisphere, formed and named by Helvetius. It is surrounded by the Camelopard, the Great Bear, Leo Minor, and the modern constellation called Herschel's Telescope. Its largest stars are of the fourth magnitude only.

LYON KING-AT-ARMS. (*See* HERALDS' COLLEGE.)

LYRA, *li'-ra* (Lat., a lyre), in Anat., is the name given to a portion of the brain, between the posterior crura of the fornix of the cerebrum, and marked with prominent medullary fibres, so as to give it the appearance of a lyre.

LYRE, *lire* (Lat.), the most primitive of all stringed instruments, invented, according to the traditions of the Egyptians, by Mercury, in the year of the world 2000. We find it first spoken of under this name by Aristophanes, it is also mentioned by Aymeric in the Life of Charlemagne. The Greeks, in all probability, derived their lyre from the Egyptians. It was at a very early period of its existence undoubtedly capable, even with a very few strings, of producing a great variety of sounds differing in pitch. At first it possessed only three strings; to these, however, one was afterwards added by the Muses, and one each by Orpheus, Linus, and Thamyris; thus forming it into a heptachord: this number was at last increased to eleven. The lyre was of a very graceful form, possessing a hollow body to swell the sound, and was played upon with a *plectrum*, or lyre-stick, of ivory or polished wood. Some lyres are said to have been constructed of tortoise-shell. One was invented by Leonardo da Vinci in the shape of a horse's skull. The ancient names for this instrument were, *lyra phorminx*, *chelys*, *barbitos*, *barbiton*, and *cithara*.

LYRIC POETRY, *lir'-ik*, is commonly understood to be poetry intended to be sung or accompanied with music. This distinction was not at first peculiar to any particular species of poetry, for, originally, music and poetry were always joined together. After a time, the bards began to compose pieces which were to be recited or read, not to be sung, such poems as were still designed to be joined with music were, by way of distinction, called odes. The ode was that form of poetry under which the original bards poured forth their enthusiastic strains, praised their gods and their heroes, celebrated their victories, and lamented their misfortunes It was chiefly in the spirit and manner of its execution that it was distinguished from other kinds of poetry. The subject being of a lofty and transporting nature, justified a bolder and more passionate strain than belonged to the simple narrative. Hence the enthusiasm that belongs to it, and the liberties it is allowed to take beyond any other species of poetry. Hence, too, that neglect of regularity, those digressions, and that disorder which it is supposed to admit of The term lyric poetry is commonly applied to all kinds of verse that partake in any degree of the characteristics of that to which it was first applied Thus we have lyrical ballads, which might with equal propriety be termed epical, and hear of the lyrical measures of Horace, where we have no ground to suppose that they were sung, and which have no fitness for musical rehearsal A writer in the "English Cyclopædia," in distinguishing between lyric and epic poetry, defines the former to be "that class of poetry which has reference to, and is engaged in delineating, the composer's own thoughts and feelings, as distinguished from epic poetry, which details external circumstances and events" The ancient Greeks speak of nine as the principal of their lyric poets; viz., Alcman, Alcæus, Sappho, Stesichorus, Ibycus, Anacreon, Simonides, Pindar, and Bacchylides; but, with the exception of Anacreon and Pindar, nothing remains to us of the works of these authors but a few fragments. To these two, however, the judgment of all has ascribed the palm of pre-eminence in lyric poetry. Each of these excels in his particular line Anacreon sings of women and roses and wine; Pindar, of heroes, of public contests, of victories, and laurels. The one melts away in amatory softness; the other is ever like a foaming steed of the race, vaulting in the pride of conscious strength, or the furious war-horse, dashing fearlessly on over every obstacle. Under these masters, Grecian lyrics were advanced to their greatest perfection. Among the Romans, who principally followed the Greek models, Horace stands almost alone as the

representative of Greek poetry. To him, even the Greeks themselves can present a superior only in the bold and lofty Pindar. That Horace borrowed freely from the Greeks has been clearly shown, yet the universal admiration that his odes have awakened is manifest proof of the power of his genius. The most important branch of the Roman lyric is satire. English lyric poetry, strictly so called, is late in its full development. Scarcely any poems occur before the time of Milton that are worthy of the name of lyrical. In "Lycidas," "Il Penseroso," and "L'Allegro," we have, perhaps, the most beautiful examples of which our language can boast. In Dryden, Pope, Gray, and Cowley, we meet with some good specimens of lyrics. The works of Wordsworth and Coleridge are eminently lyrical in their character, and our present laureate, Tennyson, has produced a number of beautiful specimens of lyric poetry. *Lyric poetry* is said, from its nature, to have "flourished better at court than the dramatic and epic, both of which, like history, require liberty, because they [illegible] truly the character of man, in his [illegible] which cannot be done but by viewing life impartially, and depicting it freely; whilst the lyric poet, in most of his highest efforts, aims to express his adoration,—be it of a hero, or his mistress, or nature, or God, and this tone coincides well with the adulation of courts. Hence, when the drama and epic have gone down with the decay of national independence and spirit, and genius, debarred from action, lives only in contemplation, lyric poetry continues, and not unfrequently even flourishes; because man always *feels*,—adoration, love, and hatred cannot die."

Lyrus, *li'-rus* (Gr. *lura*, a harp or lyre), one of the old constellations of Aratus and Ptolemy, supposed to represent the lyre that was carried by Mercury. It is situated in the northern hemisphere, to the south of the constellation Draco, having Cygnus on one side and Hercules on the other. The name Vega is given to its largest star, which is one of the first magnitude, and situated nearly in the centre of the constellation.

Lythraceæ, *li-thrai'-se-e* (from Gr. *luthron*, blood mingled with dust, because of its colour), in Bot., the Loose-strife fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciflora*, having the following essential characters:—Herbs or shrubs, with entire, exstipulate, and usually opposite leaves. Calyx tubular, ribbed, persistent, bearing deciduous petals and stamens, the latter being inserted below the petals; anthers 2-celled, adnate, bursting longitudinally, ovary superior, with axile placentation, style 1. Fruit membranous, dehiscent, surrounded by the non-adherent calyx. Seeds numerous, exalbuminous. The greater number of these plants are tropical, but a few are found in the temperate regions of Europe and North America. The species *Lythrum Salicaria* is the purple loosestrife, a common British plant. This is said to be useful as an astringent in diarrhœa. The order contains 35 known genera and about 300 species.

M.

M, *em*, is the thirteenth letter and the tenth consonant of the English alphabet. It is the labial letter of the liquid series, and in all positions has one uniform well-known sound, as in *man*, *camp*, *jam*. It is pronounced, says Ben Jonson, with a kind of humming inward, the lips closed; open and full in the beginning, obscure in the end, and meanly in the midst. It is one of the easiest to articulate, and is therefore one of the first uttered by children, and in most languages it forms a prominent letter in the words for mother. The letter *m* has a place in all known languages, and the English sound of it is that which it has also in most of the European tongues. In French and Portuguese, however, at the end of a word, and in most cases at the end of a syllable, it loses its proper sound, and serves only to give a nasal sound to the vowel which precedes it. Among the ancient Romans, too, *m* was but very faintly pronounced, being rather a rest between two syllables than an articulation; and hence it was subject to elision. *M* passes easily into other letters, losing itself in the preceding or succeeding letters,—a circumstance which the etymologist must bear in mind in seeking the derivation or connection of words having that letter in their root. *M* interchanges with *n*, *b*, *p*, *v*, and *w*, and frequently disappears altogether. Like other liquids, it also not unfrequently changes its position with regard to the vowel of a root. The Greek and Hebrew *m*, as a numeral, denoted 40; the Roman *m* (probably as being the initial letter of *mille*, a thousand) denoted 1,000; and this is its numerical value in English. *M* is likewise used by printers for the unit of measure of printed matter. Types of the same fount have bodies of equal thickness in one direction, and the square of this dimension is used in determining the amount of printed matter in a given space, and is termed an *m*.

Mab, *māb*, is the name of a fairy celebrated by Shakespeare and other English poets. The name has been variously derived; but the most probable derivation of it is from the Cymric *mab*, a child. According to Voss and others, Mab was not the queen of the fairies, that dignity having been ascribed to her from a mistaken use of the old English word queen, or quean, which meant only a woman.

Macadamizing, *măk-ăd-ăm-ī'-zing*, a method of forming roads, invented by Mr. M'Adam, whose name is perpetuated in the verb *to macadamize*. In this method the road is made entirely of angular pieces of stone, without any kind of binding material. The stones used for this purpose must be hard and tough, such as the whinstones, basalts, granites, and beach pebbles, so that they may resist the action of the wheels. Hardness alone is not sufficient, for flintstones are hard but brittle, and are soon crushed into powder, as are also the softer sandstones. The angular stone fragments used in macadamizing must be of such a size as to pass freely, by their largest dimensions, through a ring 2½ inches in diameter.

Macaronic Verses, *măk-ă-rŏ'-nik* (Fr. *macaronique*, from Ital. *maccheroni*), is a species of ludicrous metrical composition, in which the words of a modern language are Latinized. It is said to have been invented by Theophilo Folengo, a Benedictine monk of Casino, who flourished early in the 16th century, and wrote under the name of Merlino Coccaio. His principal poem, "Maccaronea," is a burlesque mixture of Latin, Italian, Tuscan, and plebeian words and forms, and satirically narrates the adventures of its hero until he finally arrives in hell, the three last books being a [illegible] of Dante's "Inferno." In the preface, [illegible] to the work, he describes this new [illegible], deriving its name from macaroni; because, like that mélange, it should be coarse and popular. Antonius de Arena, a lawyer at Avignon, wrote in this style as early, some say as 1519; and it soon became highly fashionable in England, France, Germany, and Italy. Macaronics were fondly cherished by Rabelais, who often referred to Merlin the Cook (Coccaio). John Skelton introduced it into England in the reign of Henry VII., and it continued fashionable during the reign of Elizabeth. Dunbar, a Scotch poet of Skelton's own age, was also distinguished in this way. His "Testament of Maister Andro Kennedy" represents the character of an idle, dissolute scholar, and ridicules the funeral ceremonies of the Romish church, almost every alternate line being composed of the formularies of a Latin will and shreds of the breviary. Thus,—

> "I will no priestis for me sing,
> *Dies ille, dies iræ;*
> Nor yet no bellis for me ring,
> *Sicut semper solet fieri,*
> But a bag-pyp to play a spring,
> *Et unum ale-wisp ante me,*" &c.

Drummond of Hawthornden has also written in this style. His "Polemo Middinia," or War on a Dunghill, describes a feud between two fishwomen, Vitarba (the Lady Scotstarbet) and Neberna (the Lady Newbarns). The following are some of the assistants whom Neberna summons to her aid:—

> Convocat extemplo barrowmannos atque ladæos,
> Tumultuansque simul reckoso ex kitchene boyos,
> Hunc qui dirtiferas tersit cum dishelouty dishas,
> Hunc qui gruelias scivit bene lickere plettas,

"Coalheughos nigri grinantes more divelli,
Maggyam magis doctam milkare cowsas,
Et doctam sueparo flouras et sternere beddas
Nansyam, claves bene quæ keepaverat omnes,
Quæque lanam cardare solet greasy-fingria Betty"

The following is an account (from the *Frostiados*, in pamphlet entitled "The University Snowdrop") of one of the Edinburgh "bickers," which are of more than local celebrity.—

"Anno incipiente happenabit snowere multum
Et gelu intensum streetas coverabit wi' slidas,
Constanterque little boys slided et pitched abou'
snowballs,
Quorum not a few bunged up the eyes of studente'
Irritate, studentes chargebant policemen to take up
Little boys, sed Charlies refusabant so for to
then
Contemptim studentes appellabant 'Pedicatores.'
Studentes indignant reverberant compliment
Cum multi homines 'blackguards' qui gentlemen
vocant,
Bakers, et butchers, et bullies, et colliers atras,
Et alios, cessatores qui locus ecclesiæ frequent
'Iron Church' et Cowgate cum its odoriferou'
abyss.
Assaultant studentes sticks et umberellibus
'Hit 'im hard! hit 'im hard!' shoutant 'darn nato'
puppies,'
'Catafoitosque torios' appellant et various vile
terms
Studentes audiebant, sed devil an answer returned'

The author of the following book inscription seem resolved, at all hazards, to maintain his right of property:—

"Si quisquis furetur
This little libellum,
Per Phœbum, per Jovem,
I'll kill him! I'll fell him;
In ventrem illius
I'll stick my scalpellum,
And teach him to steal
My little libellum."

Some very successful macaronics have appeared in *Punch*.—Ref. *Macaroneana, ou Mélanges de Littérature macaronique des différents peuples de l'Europe*, par M. O. Delepierre, Paris, 1852, *De la Littérature macaronique et de quelques Raretés bibliographiques de ce genre*, par M. O. Delepierre, 1856.

MACAW, *ma-kaw'* (*Macrocercus*), a bird belonging to the family *Psittacidæ*, or Parrot tribe, and distinguished from other *Scansores* (the class of the family, so named from their being climbers) by reason of their having their cheeks destitute of feathers, and their tail feathers long. They are natives of South America, where they are covered. The scarlet macaw, *Ara* (*macrocercus*) *Macao*, is, perhaps, the most splendid, as well as the largest species of the entire parrot family. Some of them measure thirty-six inches and more from the tip of the bill to the extremity of the tail, and their plumage is a bright scarlet, relieved with blue, yellow, and green. The great green macaw, *Ara* (*macrocercus*) *militaris*, is a native of the Andes, where it is often found at an elevation of 3,000 feet from the sea. In former times this bird used to be presented, as an inestimable gift, by the Indians to their Incas, who valued the macaw extremely. It is extremely gregarious and mischievous, by reason of its predatory nature, as it commits great damage upon plantations and gardens, which it plunders right and left. The characteristics of the macaw are the same as the rest of the *Psittacidæ*, and will be found given under the article PARROT FAMILY.

MACCABEES, BOOKS OF, *măk'-a-beez*, is the name given to certain apocryphal books of the Old Testament, containing principally the details of the struggle of the Jews against the ... the Syrian kings ... the Maccabees. The books are connected only by their subjects, being by different authors, and of widely unequal literary merit. The two first in order were declared canonical by the councils of Florence and Trent, and are also contained in the original translation of Luther. The first book of Maccabees contains a history of the Jews from the reign of Antiochus Epiphanes till the death of the Jewish priest Simon, *i. e.* from 175 to 135 B.C. It may be divided into four parts; viz.,—1. From the commencement of Antiochus Epiphanes's reign till the death of Mattathias (i. ii.), 2. the history of the presidency of Judas Maccabeus (iii.—ix. 22); 3. the government and high priesthood of Jonathan (ix. 23—xii. 53); 4. history of the high-priest Simon (xiii.—xvi.). The Greek text of the Septuagint version is the original of all the others; but there is little doubt that it was written originally in Hebrew. Of the author nothing is known; but he must have been a Palestinian Jew, and have lived some time after the events recorded in the book. Though ... unsatisfactorily defective and ... extravagant, it is upon the whole entitled to credit for general accuracy. The second book of Maccabees is inferior in many respects to the first in simplicity, credibility, naturalness, correctness, &c. It professes to be an abridgment of an earlier historical work by a Jewish writer of Cyrene, named Jason, relating the principal events of Jewish history in the reigns of Seleucus IV., Antiochus Epiphanes, and Antiochus Eupator. It partly goes over the same ground with the first book, but commences ten or twelve years earlier, and embraces in all a period of fifteen years. The precise age, either of the author or his predecessor Jason, is unknown. The two letters with which the book begins are generally regarded as spurious, and the other parts abound with inaccuracies, and even self-contradictions. The third book of Maccabees is prior in time to the first and second, and, indeed, does not touch on the time of the Maccabean heroes. It gives an account of a sacrilegious attempt of Ptolemy Philopator, after his victory over Antiochus the Great, at Raphia (217 B.C.), to enter the holy of holies at Jerusalem, which was baffled by a miracle. Upon his return to Egypt he resolved to avenge himself upon the Jews there; and those of them who would not consent to be initiated into the orgies of Bacchus, he caused to be chained in the great circus at Alexandria, in order to be trampled to death by elephants. Two angels appeared, in a terrible form, between the Jews and the elephants, when the latter went backwards and crushed the soldiers. The king caused the Jews to be released, appointed a festival, and made an edict that none of his subjects should injure a Jew on account of his religion. The author and his age are both unknown, and, indeed, the entire history is nothing else than a most absurd Jewish fable. The fourth book of Maccabees is generally supposed to be the same with the "... of Reason," attributed to Josephus by ..., and others. It contains an ascetic treatise on the dominion of right reason over the passions, as illustrated by the history of the martyrdom of Eleazar, the seven brothers, and their mother, being an inflated ... of that history as given in 2 Macc. vi. vii. The author makes many historical blunders, and the whole manner and diction disprove it to be the work of Josephus. Nothing is known of its author, and it is believed not to be earlier than the 2nd century of our era. The fifth book of Maccabees is now extant only in the Arabic. It comprises a history of Jewish affairs from the attempt on the treasury at Jerusalem by Heliodorus, and brings it down to the extermination of the house of the Maccabees by Herod the Great. The work was originally written in Hebrew, but who the translator was it is impossible to say; but he seems to have lived after the destruction of the temple at Jerusalem by Titus. Only the first two books of Maccabees are printed in the Apocrypha of King James's version.

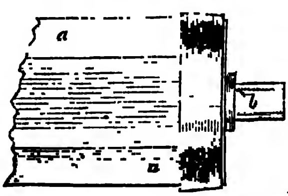
MACE, *maise*, a term of doubtful etymology, originally ... of metal used in warfare. The ... impenetrable ... was used as an instrument of effectual demolition. In its simplest ... was only a short strong iron club, and its shape varied among different nations and at different times: sometimes a ball was attached to the end by a triple chain. At present the mace, in a more ornamental form, is used as an ensign of authority borne before magistrates; of this kind is the mace placed before the Speaker of the House of Commons whilst

that officer presides at the sittings of the House. In a "committee of the whole house," or when any other member presides in the place of the Speaker, the mace is laid under the table. When Cromwell dissolved the Long Parliament, he stigmatized the mace as "a bauble," and ordered it to be "taken away." The old mace of the House of Commons was broken up, melted, and sold by order of the House, Aug 9th, 1649.

MACE, in Bot. (*See* MYRISTICA.)

MACERATION, *mās-e-ray'-shun* (Lat. *macero*, I soften with water), is the infusion of substances in cold liquids. The term is usually employed with regard to vegetable substances, when they are reduced to powder and exposed to the action of water, or any other liquid, without the assistance of heat, in which last respect it differs from *digestion*. Maceration is useful either when it is required merely to soften the parts of the substance operated on, as when cinnamon and cloves are macerated in water before distillation, or in cases where heat would be injurious, as when volatile or aromatic substances are used.

MACHIAVELLIANISM, *māk-e-a-vel'-le-an-izm*, is a term applied to a detestable system of politics, after Nicolo Machiavelli, a native of Florence (1469—1527). The obnoxious principles are set forth more particularly in a work of his called "Il Principe." The meaning and object of this work have been much discussed, but from a letter of the author's, discovered only in 1810, in which he speaks of being then engaged upon it, there can be little doubt that is was written with a view to recommend himself to the Medici. The "Principe" is an account of how tyrannical power is to be acquired and preserved,—by overlooking every law, and making use of any means, however criminal, to promote its purposes. Some have regarded the work as satirical; others that its object was to make tyrants odious, others that he was desirous of seeing a free and united Italy, and that he believed any means to be lawful for the attainment of that object. In judging of the work, we must take into account the circumstances and character of the times in which it was written. Had his book taken the form of a commentary upon history, all that he says would have only been matter of fact; but whatever may be the character of the book, the term Machiavellianism is used to denote whatever is infamous and perfidious in politics.



MACHICOLATION, *mā'-shik-o-lai-shun* (Fr *māchecoulis*, from *mèches*, lighted materials; *couler*, to pour down), a term bestowed on those openings in the parapet of a fortified building through which ignited substances, or melted lead, stones, &c., were poured or hurled down at the besiegers. Machicolations were made in the soffit or under surface of the projecting parapet, which was supported on corbel-stones, the perforations themselves being in the soffit between those stones. By means of these arrangements the besieged, while protected by the parapet, were enabled to harass the attacking party in a most formidable manner.

MACHINES, ESSENTIAL PARTS OF.—In communicating motion from one point to another, and for supporting the assemblage of wheels, pulleys, and the various modifications of mechanical powers which may be adopted for this purpose, contrivances known as "shafts" are used. When of considerable diameter, this is the term by which they are known; when of comparatively small dimensions they are called "spindles." Shafts are of two kinds, "horizontal" and "vertical;" the former being used when motion is to be communicated from one end of a room to the other, or similar positions; "vertical," where it is to be taken from a low to a high position, as from the engine on the ground-floor of a factory to the various floors above. Shafts, up till a comparatively recent period, material is now seldom used, cast and malleable iron being alone employed. The former is generally adopted in the case of heavy shafts, while the latter is almost always employed for shafts of comparatively minor diameters. Shafts are composed of two portions,—the "body" and the "gudgeons," or "journals." The latter term denominates the parts on which the shafts revolve, and in small iron shafts are formed by merely making a certain portion circular and smooth by being carefully turned in a lathe. Thus, in fig. 1, *c c* is the body of the shaft, while *b*, *b* are the "journals." When shafts are made of wood, oak in a solid mass is used, or they are *built* of lengths of fir. Sometimes they are made octagonal, or have the corners roughly

Fig. 1.

taken off; more generally they are left square. As it is evident that the journals must be of some better or more durable material than that which forms the body of the shaft, cast iron is usually adopted for this position; hence arises a necessity for having an efficient method of fastening the journals, thus necessarily separate, to the body of the shaft, in such a manner that they shall, as nearly as possible, approximate to the condition of a shaft perfectly solid and stable throughout its length. We here figure one of the methods adopted to attain this desideratum. Thus, suppose *a a*, fig. 2, to be part of a wooden octagonal shaft, mortises or apertures are made in the end of the shaft of a certain depth, and of shape and width corresponding to the "cross-tails" *d d*, cast round the journal *b*; these arms are let into the mortises on the

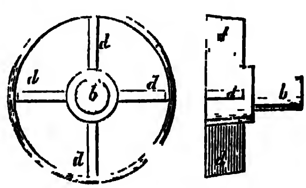


Fig. 2.

end of the shaft and driven home; a hoop of metal, *c c*, is put over the end of the shaft in a heated state, then carefully wedged up; on cooling, the hoop closely binds the end of the shaft and the ends of the cross-tails *d*, *d*. When large shafts are used, as in water-wheels, where the motion is slow, they are made of cast iron and *hollow*. In this case the journals are sometimes inserted, as shown in the sketch, fig. 3: *b b*

Fig. 3.

is a projecting flange, cast round the end of the shaft *a a*; the interior of this is carefully bored, to receive the part *c c* of the journal *d*, which is turned of the same diameter as *b b'* the parts are held together by the bolts *e e*, passing through the projecting flanges, and secured by nuts. The method of fixing wheels,

on which the wheel is to be fixed: it is called the "boss," and is of larger diameter than the body *a*; *b* is the journal, terminated by two projections, commonly

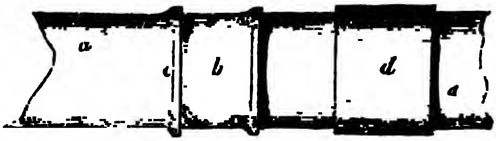


Fig. 4.

called "ruffs" or "collars" As the "eye" or centre of a wheel to be fixed on a circular shaft is generally

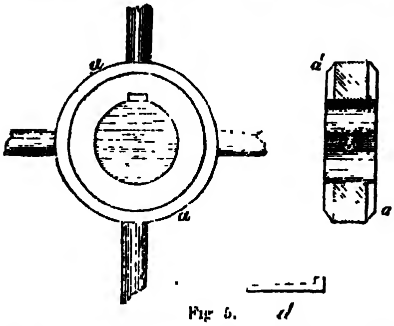


Fig. 5.

bored out, it is necessary that there should be some means adopted to prevent the wheel from turning round or shifting on the shaft. This is effected by cutting, in the first place, a longitudinal "slot," or groove, along the inside of the eye of the wheel or pulley, as in fig 5 at *b*, this may be done at only one side, or at both ends of the diameter, in some cases four are made the parts cut out are termed "key-seats." Part of the boss of the shaft is next made flat by means of appropriate tools, the wheel is put on the boss with the slot opposite this flat part, a key, as *d*, is then inserted in the slot and driven home; acting as a wedge, the wheel is prevented from slipping round the shaft In some cylindrical shafts ribs or projections are cast, as in figs. 6 and 7, *b b* fig. 7 is a section of fig. 6. Where shafts are made square, as in fig. 8, the eye of the wheel being made square, by cutting key-seats in it, it may be fixed easily on any part: *c c* are the journals, *a a* the body of the shaft, *b* a section through the body. As a general rule, the journals of shafts should be of the same diameter: enough should be merely taken off to form them, leaving depth enough to keep the journals in the brasses This brings us to the next important feature in this department of machinery, namely, the "bearings" by which shafts are supported and in which they revolve. They are generally known as "plummer" or "plummet blocks," or "pedestals." They consist of two parts,—the "sole," *a' a'*, or part which is bolted down to the standard or frame *e e*, fig. 9, by the bolts *d d*, and the "cover" *a*, which is secured to the sole by bolts passing through it, as in the sketch. The journal of the shaft revolves in a space (*f f*) left in the centre of the block. In order to prevent, as much as possible, loss of power by friction, the shaft journal is made to revolve within "brasses" or "pillows," made of brass, or a mixture of copper and zinc. In fig 10, a front and side view of a brass generally used is given The part *b* is that which is placed in the sole of the block; *a* that placed in the cover. They have both projecting flanges, which embrace the sides of the block *c c* is the journal. In some cases the brasses are made octagonal in form, as in fig. 11, where *b b* are the upper and lower brasses, and *d* the journal. It is evident that as the sides of the brass will embrace those of the block, as *f*, fig. 9, the brasses will be prevented from turning round. Another method of keeping the brasses in their place is shown in fig 12, where a projecting snug, or rib (*b*), is made beneath the brass *a a* this fits into a slot (*d*) made in the cover or sole of the pedestal, part of which is shown in the figure This plan is generally used where the brass is made circular; this allows the

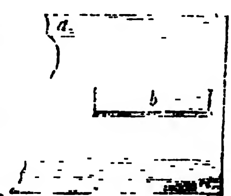


Fig 6.

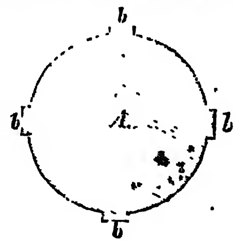


Fig 7.

Fig. 8.

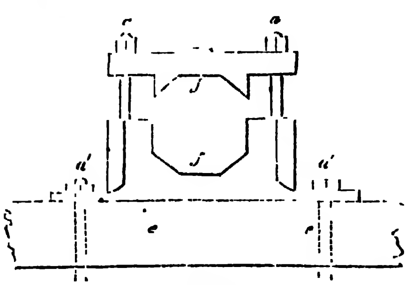


Fig. 9.

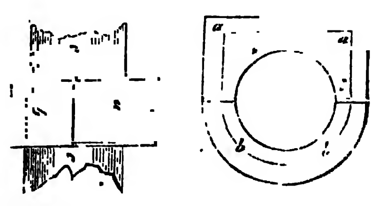


Fig. 10

space in the block to be accurately bored out to the size required. The method by which the brasses of

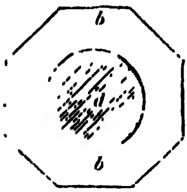


Fig 11

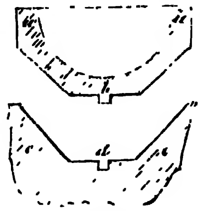


Fig. 12

connecting-rods, &c., are made to embrace the journals may be described here. Suppose *m*, fig 13 to be the journal crank-pin, *b b* the lower half of the brass, *d d* the upper half, a strap (*a a*) is made with one end circular, which embraces the lower brass *b b*; a space (*a a*, fig 14) is cut out on each side, the butt *e* of the connecting-rod is of breadth sufficient to pass easily down between the sides of the strap; a space is also cut through this, as at *m*, fig 15, at such a distance from its extremity, that when placed within the strap at its proper place, the space through it and those in the strap coincide. The end of the brass being kept in its place by the projecting rib *c*, fig 13, it is very frequently made with projecting flanges, as in fig. 10, in this

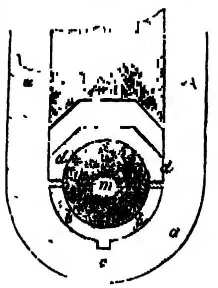


Fig 13

case the breadth of the strap *a a* is so that it can pass easily between the flanges. The manner in which these parts are kept together is as follows: the brasses are made to embrace the journal; the strap is then passed over these, so that the inner curve presses against the outer curve of the lowest brass; the butt of the connecting-rod is then passed between the sides of the strap; the key is then passed through the space, or slot, and driven home. When the brasses begin to wear, and the journal works loose between them, by tightening the keys the brasses are brought close together, to admit of this, they are originally fitted so as to leave a space between them, as in the sketch. In fig. 16 we show another form of connecting-rod but

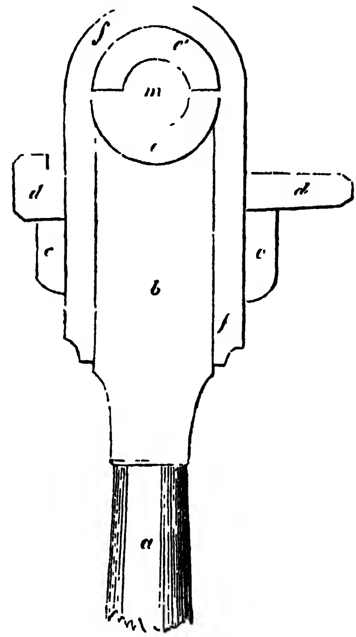


Fig. 16.

strap, and brasses *m*, the end of the journal; *c*, *c*, the brasses *f f*, the strap; *b*, the butt of the connecting-rod *a* by driving home the key *d d*, the gib *c c* is tightened; this lowers the strap, and tightens up the end of the brass *c*. In fig 17 we give a front and end view of a plummer-block, showing the connection of all its parts: *e e* is the standard, or frame, to which the sole *a a* is bolted by the bolts and nuts *d d*, the

Fig. 14.

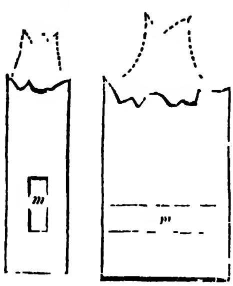


Fig 15.

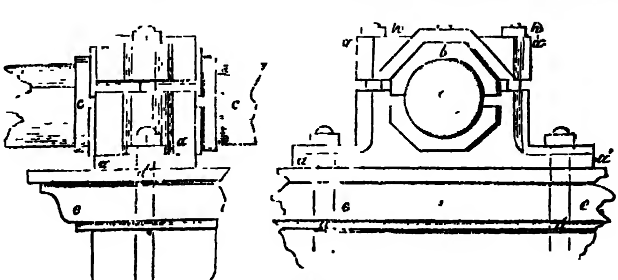


Fig. 17.

Machines

cover *a a* is bolted to the sole by the bolts *h*, *h*; *b*, *b* the brasses, or pillows. As these wear, they are brought in closer contact with the journal by tightening the bolts *h*, *h*; *c*, the shaft. Another form, showing a method adopted of making the bearing in a steam-

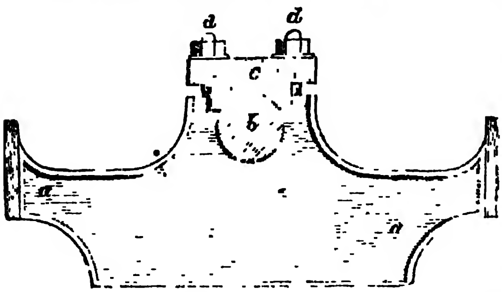


Fig. 18.

boat engine, is given in fig. 18 *a a* is part of the side-framing; *b*, the shaft, *c*, the cover, *d*, *d*, the bolts for securing this. The bearings for vertical

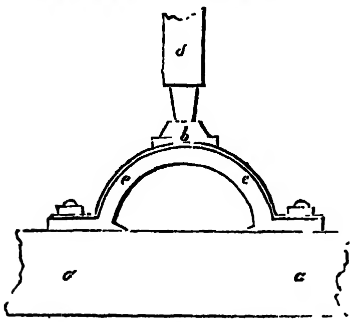


Fig. 19.

shafts are formed by having the brass generally hollowed out, somewhat like a cup, placed in a footstep

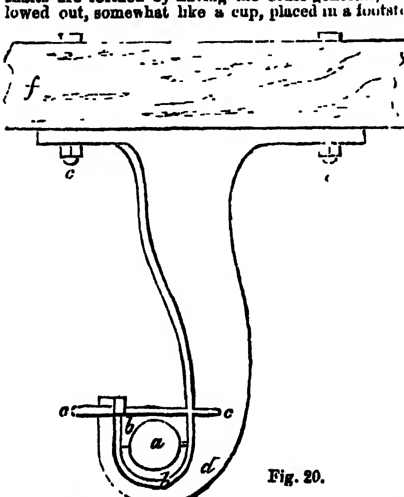


Fig. 20.

Machines

(*b*, fig. 19), which is secured to a footbridge of cast iron (*e e*) adjusted in the plate placed on the block of stone *a a*. The end of the shaft *d* is formed so as to work easily in the cup-shaped brass. In order to adjust plummer-blocks upon the stands to which they are fixed, it is usual to adopt a foundation-plate, on which two projecting snugs are cast; the sole of the block goes into the space between them, and wedges or keys are driven up at the ends; thus any lateral adjustment can be made by driving the keys correspondingly. When the height of the block is to be altered, pieces of wood or thick mill-board are placed between the sole and foundation-plate. When shafts are to be carried a short distance beneath a ceiling, a different form of bearing is used, one generally adopted is shown in fig. 20. It is denominated a "gallows," or pendent bracket; *f* is the beam or joist to which the gallows is suspended, the plate of the gallows *d* is fixed to the beam by the bolts *c*, *c*; *a* is the revolving-shaft; *b*, *b*, the brasses; *c c*, the key by which the brasses are brought close contact with the journal as the former wear away. Where shafts are carried along the front of a wall, the bearings are what are termed brackets, as in fig. 21, where *a a* is the wall, *d* the bracket projecting from it, sufficiently to allow wheels, pulleys, &c., to revolve freely without coming in contact therewith. A wall-plate, as *b*, is used to serve as a foundation on which to adjust the bracket; it is bolted firmly to the wall, and the bracket adjusted thereto by bolts and keys. In cases where only one end of a shaft is supported by a separate frame, as in some kinds of ..., the other extremity works in a bearing placed in an aperture made in the wall opposite to which the framing is placed, the aperture in the wall is provided with a cast-iron box, of depth equal to the breadth of the shelf, which serves as a foundation-plate on which to adjust the block. Thus, in fig. 22, *a a* is the wall, *b b* the wall-box, *c* the plummer-block, *d* the shaft, the other end of which revolves in a bearing placed on the top of the framing of the steam-engine, or otherwise placed, as the case may be. In some cases where the shaft has to be continued to the other side of the wall, for communicating motion to machines there placed, the wall-box is simply a frame or box contained within four sides, and provided with a shelf as above stated; in place of a separate shelf, the bottom side of the box is made to serve as the plate on which to adjust the bearing, as in fig 22. Where shafts are required of too great a length to admit of their being cast or made in one piece, contrivances are resorted to by which two or more lengths are joined together. These are known as "couplings." Couplings are of two kinds or classes,—those having two bearings, and those having one. By this time the pupil will understand the term bearing, meaning thereby the plummer-blocks or pedestals on which the journals of the shafts revolve. Theoretically, the construction of couplings is a matter of extreme simplicity; on the supposition that the shafts remain always as fitted up at first, it is an easy matter to adopt means by which shafts can be coupled together effectually. But in practice the difficulty is increased from the wearing of the journals, brasses, sinking and altering of foundations, and from other causes; many adverse circumstances are called into

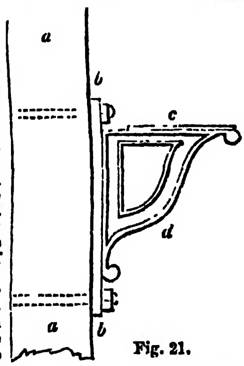


Fig. 21.

play, which make it a matter of practical difficulty to find a form of coupling which will answer to the ex-

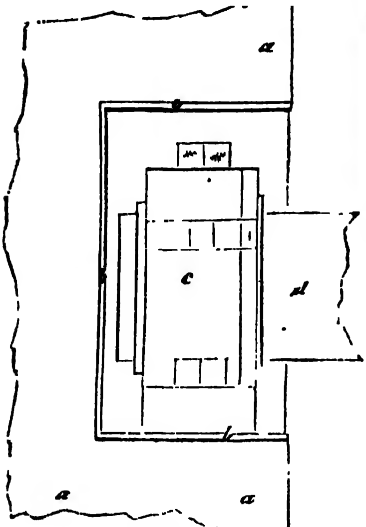


Fig 22

pectations of theory Hence the number of variations of couplings. To notice a few of these will suffice for our purpose. The "square coupling" is shown in

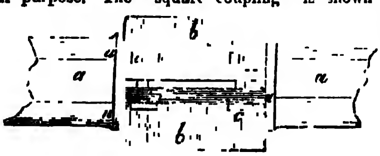


Fig. 23

figs. 23 and 24, the latter being a transverse section through the centre of the coupling, the ends a', a' of

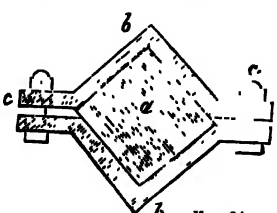


Fig 24.

the shafts a a are made square, and put together end to end; they are then embraced by a "coupling-box" b b, placed diagonally on the shaft; the inside of the box is fitted to the exact size of the squares of the shafts; it is also provided with flanges, through which bolts are passed, and secured by nuts, c, c. In some instances the coupling-box is made in one piece, and the square parts of the shafts are together rather longer than the length of the box: this enables the latter to be slid past the joint, and allows the two shafts to be disengaged without removing the box. This form of coupling, though apparently simple and effective, is liable very speedily to get out of repair, inasmuch as the bearings are apt to wear unequally; the result of this is, that in each revolution one or other of the shafts will be lifted off its bearings: this produces unsteady motion, and hence further twisting and wearing of the coupling. This form is therefore rarely used in heavy mill-work, being chiefly confined to small machinery. The "round coupling" is shown in fig. 25, part of which is shown in section, the upper

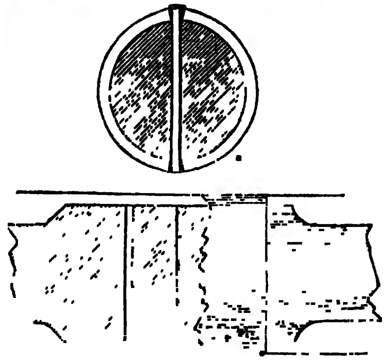


Fig. 25.

figure being a cross section. In this form the ends of the shafts are made cylindrical and faced so as to lie close up to one another; a coupling-box is passed over the ends and secured by pins passing through the box and shafts at right angles to one another. In this form the shafts and box can be more accurately fitted; but as the strain is obviously concentrated on the pins and holes, the former in a short time become loose, and have to be replaced by new ones, these, of course, not being fitted with the same accuracy to the holes as in the first instance. In some cases, shafts having two bearings as those last described—are coupled together without the use of coupling-boxes, in this case the couplings are denominated "clutches," or "glands." "Glands," says an eminent authority, "are an excellent mode of coupling for double bearings, and have the advantage of throwing the stress farther from the centre of motion than in the square coupling as commonly executed." In fig. 26, d and c are parts

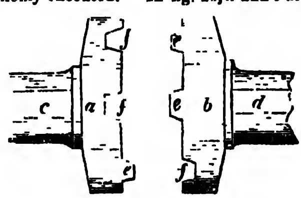


Fig. 26.

of the shafts to be coupled, having the bearings at c, d; at the ends of the shafts, round plates, a, b, are cast, in the face of these, projections and recesses are cast;

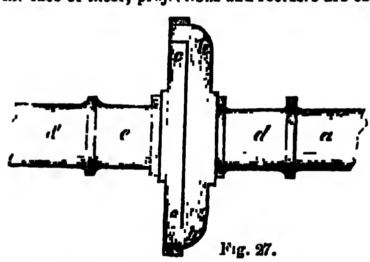


Fig. 27.

the projections go into the recesses, thus locking the two plates fast. Another form is given in fig. 27: the

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shafts d', a, having their bearings at d, e, have crosses ($c\,c$, $h\,h$) attached to the ends; one of these, as $h\,h$, has its extremities curved; these, as may be seen, catch hold of the extremities of $c\,c$; thus, one shaft set in motion actuates the other. Couplings having two bearings being attended with much friction, they have been to a certain extent abandoned, and those having only one bearing used. The square and round couplings already described, by some small modifications can be adapted to couplings having only one bearing. In fig. 28 a modification of the square coupling is shown:

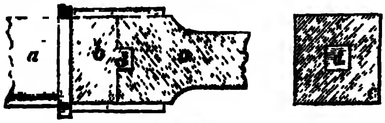

Fig. 28.

the end b of the shaft a is made square, and provided with a projection (d), which fits into a recess made in the end of the shaft c; a coupling-box passes over both squares, and is secured either by two pins passing through it and the shafts at right angles to each other, or by keys. The journal or bearing of one shaft is near the square, while the other is farthest from it. In fig. 29 the round coupling for one bearing

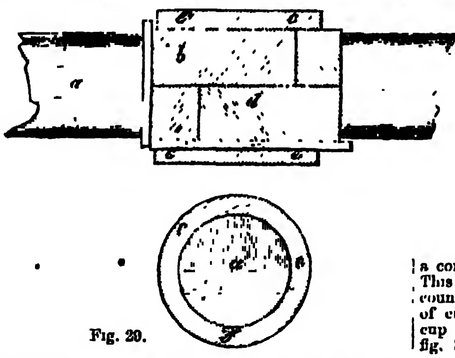

Fig. 29.

is figured; it is called the "half-lap," the shafts a, c are cylindrical at the ends, and are made with semi-cylindrical extremities (b, d), so that when laid together they form a perfect circle, the round coupling-box $e\,e$ embraces both extremities, and is prevented from moving by the key f. When carefully constructed, this coupling is not only elegant in form, but comparatively durable; it is now almost universally adopted in the better class of modern mill machinery. Where shafts require to be coupled, which are inclined to each other in their line of direction, the contrivance known as the "universal joint," invented by Dr. Hooke, is sometimes employed. A modification of this joint, as applicable to heavy mill-work, is shown in fig. 30; strong plates (c, b) are cast on the ends of

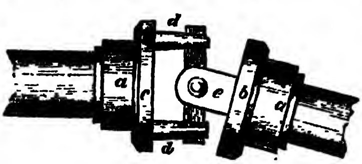

Fig. 30.

the shafts a, a; these have bearings (d, d); e for supporting the journal or gudgeon. In cases where this joint is used, the angle of inclination of the shafts should never exceed 15°: when above this, a double

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joint should be adopted, or a pair of bevil-wheels ing as in fig. 31. When the engagement or disenga

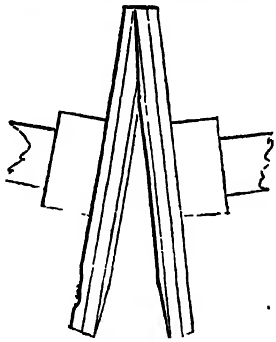

Fig. 31

ment of certain parts of machinery is desiderate other forms of couplings are adopted. As oil a other lubricating substances are employed reducing the friction between the journals haft and the brasses, or pillows, of the bearin on which they revolve, various plans are adopte for economically applying the lubricating sul stance or fluid to the parts required. The simple method adopted is by boring a hole in the upp part of the cover of a block, or the shafts

Fig. 32.

a connecting-rod or side lever ($b\,b$, fig. 32), as at c This is generally made tapered, and is what is terme counter-sunk at its upper part, a: this forms a kin of cup in which to retain the oil. An ornamenta cup is sometimes placed above the aperture, as i fig. 33, where $c\,c$ is part of the strap of th rod, b the aperture, a the vase or cup, d its cover. In place of having the oil to run directly to the part to be lubricated, thus creating a considerable waste, an ingenious and philosophical contrivance is adopted: in this, advantage is taken of the property of capillary attraction possessed by some bodies. An ornamental cup or vase (a a, fig 34) is fastened at its base (b) to the part to be lubricated; a tube (c c, fig. 35) communicates with the

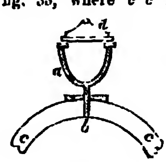

Fig. 33.

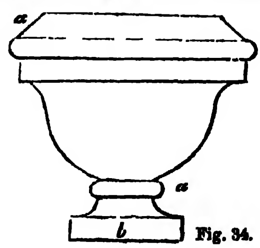

Fig. 34.

part to be lubricated, and reaches nearly to the top of the vase; a roll of worsted is passed

through this tube: one end is nearly in contact with the rubbing surface on the journal of a shaft,

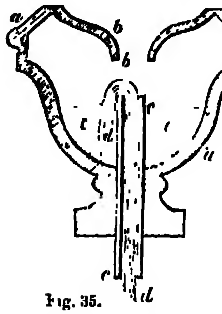

Fig. 35.

and the other reaches nearly to the bottom of the vase. The oil is conveyed throughout the whole length of the worsted. In mills, the oil is supplied to the bearings of shafts from a can with a long spout to save as much as possible of the oil dripping from the shafts, a receptacle is placed below To obviate this inconvenience and loss, Messrs Vaughan & Hossack, of Manchester, have devised a very ingenious lubricator: we show it in fig. 36. Suppose *a a* to be the

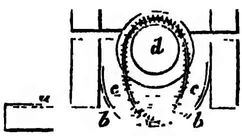

Fig. 36.

plummer-block, in which the shaft *d* revolves; a circular receptacle (*b b*) is placed beneath this; a metallic endless chain (*c c*) passes round the axle, and dips into the oil placed in *b b*. The shaft revolving, keeps the chain continually dipping different parts into the oil a supply is thus continually taken up to the shaft.

MACHINES, MOVEMENTS IN.—In this department of our subject we intend to explain and illustrate various contrivances for effecting movements in machinery. In every machine at all complicated, the movements are numerous in examining these in detail, some parts are seen having a uniform motion; in some, wheels are revolving now fast, now slow, one part having circular motion is seen imparting that which is reciprocating, while on the converse, reciprocating is changed into a circular movement; again, wheels revolving with amazing rapidity are seen to be connected with others turning at a slower speed. In some machines, as in those of the cotton-manufacture, the movements are so complicated, and apparently confused, that to the eye of the uninitiated there is presented nothing but an interminable range of whirling wheels, shafts, and spindles, the due understanding of which would seem to be a matter of almost hopeless difficulty. But to him who has studied mechanism in its various aspects, and who has been taught to analyze its movements, the difficulty is only apparent; and in process of time, by an analysis, brief but searching, the whole movements are unravelled, and from the confused and whirling mass order and regularity are deduced. It is our purpose in the present article to introduce the reader to this method of mechanical analysis, by which he may be enabled not only to understand the working details of perfect machines, but also to arrange and modify the simple elements of mechanism, considered individually, into the collective forms which may be designed for special purposes. In fig 1 is shown a method of changing the direction of motion Thus, the motion is first given to the wheel *a a*, as that of a fly-wheel of a steam-engine; it is first transmitted to *b* by the belt *c*; the pulley *e* is moved by the belt *d d* from *b*, and *g* from *e*, the pulley or shaft *g* may be driven by a diagonal belt, as seen by the dotted lines In some cases it is desirable to give the driven wheel *b* a motion in the reverse direction of the driving wheel *a*. This is effected by crossing the belt, as in fig. 2 Where a wheel drives a pinion, they revolve in contrary directions; by the interposition of a third wheel, as *b*, fig 3, the driven wheel *c* will revolve

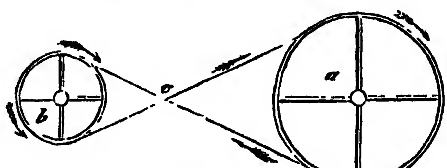

Fig. 2

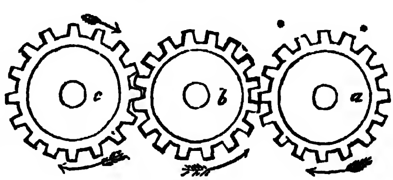

Fig. 3.

in the same direction as *a*, the driving wheel. In the contrivance known as the annular wheel, fig. 4, the driving wheel *a* has its motion in the same direction as the driven wheel *b b*. The relative velocity of wheels,

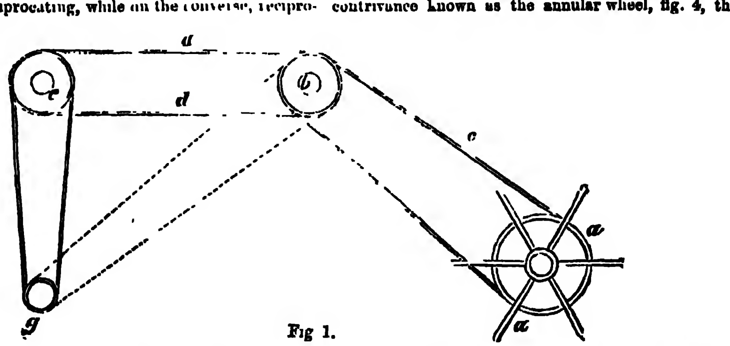

Fig 1.

shafts, &c., may be altered and modified by simple means. Fluted rollers revolving in contact, as *a b*,

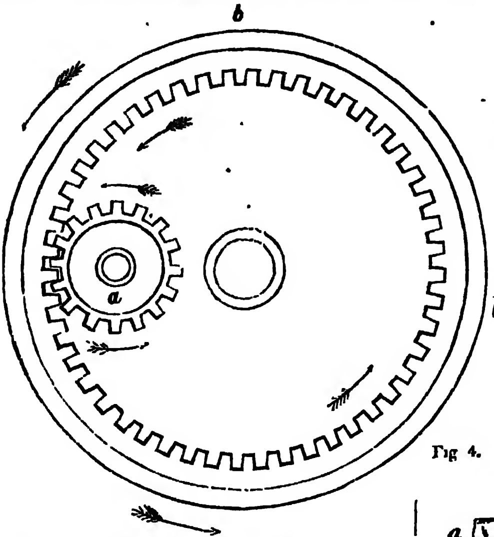

Fig 4.

fig. 5, move at the same speed if of the same size; but if *b* was only half the size of *a*, it would move twice for *a* once. In cotton-machinery rollers are much used. fig. 5 will explain one of the many modifications Suppose *a* and *b* to be revolving in contact, and making six revolutions per minute, and *c*, *d*, half the size of *a*, *b*, consequently revolving twelve times in a minute; let *e f e* be fibres of cotton passing through between the rollers *a*, *b*, and taken up by *c*, *d*; suppose *a*, *b* deliver eighteen inches per minute; as *c*, *d* revolve twice as fast, they are manifestly capable of pulling through thirty-six inches of fibre every minute; but *a*, *b* only deliver eighteen inches in that time; consequently the fibres must either be torn asunder or elongated at *f*, or somewhere between the two pair of rollers. This is just exactly as designed. The relative velocities of the rollers are so adjusted, that a certain degree of draught is given to the cotton fibres. Simple as this contrivance appears, it is that which has enabled cotton-machinery to be so marvellously quick in its operation; and without which, it may safely be said, the manufacture must have failed to reach the height of its present comparative perfection. In toothed wheels, the relative velocity of each is modified or changed by merely altering the number of teeth and diameter of wheel. Thus in fig. 6, the

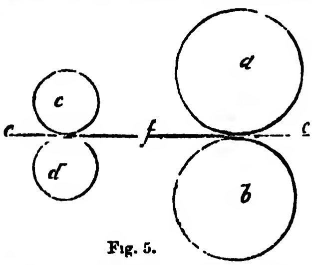

Fig. 5.

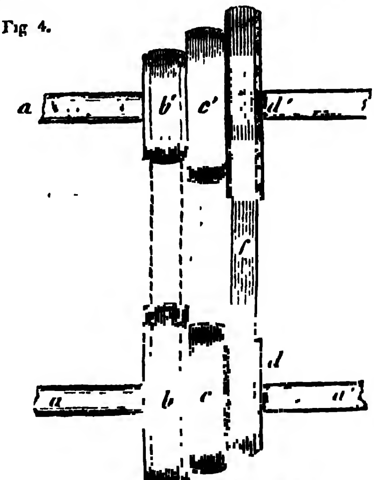

Fig 7.

velocity of the pinion *a* is nearly three times greater than that of *b*; by making *a* the driving wheel, *b* revolves only once for *a* thrice. This is the method employed in cranes for lifting heavy goods. *a* is turned by means of a handle or winch attached to its axis; the object being to give the wheel *b*, on the axis of which the barrel for winding the chain or rope is fixed, a slow motion. Where a varying velocity is required to be given to shafts, &c., the contrivance known as the "speed-pulley" is used. Suppose *a a*, fig. 7, to be the driving-shaft, communicating motion to *a' a'* by means of pulleys and belts; drums of different diameters, as *b'*, *c'*, *d'*, are fixed on *a a*, as also on *a' a'*, as at *b c d*; the small one *d* is placed opposite the large one *d'*; by shifting the belts it is obvious that the ratio of the speed of the two shafts may be altered as desired: this form is used principally in lathes. Another form is used, represented in

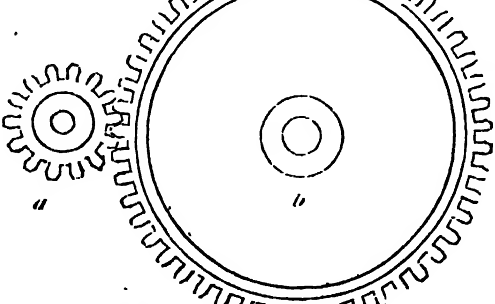

Fig. 6.

fig 9, being two conical drums placed conversely; $a\ a$ being the drum on the driving-shaft $b\ b$, $a'\ a$, being that on the driven $b'\ b'$; by moving the bolt c the relative velocities of the two shafts

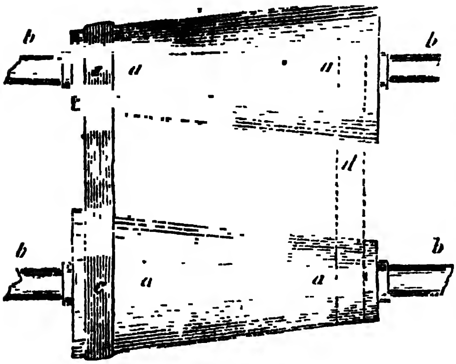

Fig 8.

may be changed [illegible] this modificati[illegible] used in the [illegible]n-machine known as the "[illegible]ng-frame" The fusee of a watch is a modification of this contri-

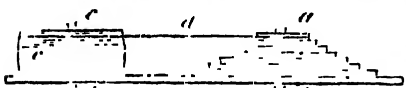

Fig 9.

vance. As is well known, the moving power is supplied by a spring wound up within a cylindrical box or barrel, $c\ c$, fig. 9, revolving on an axis in the plate $b\ b$.

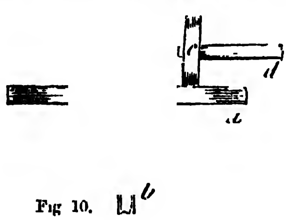

Fig 10.

On the first starting after being wound up, the spring exerting its greatest force, it would have a tendency to make the watch go very fast, thus gradually de-

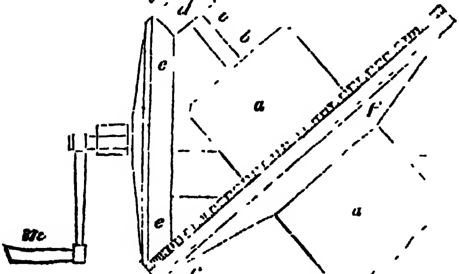

Fig. 11

creasing as it got unwound. To make its effect on the mechanism equal throughout, a chain (d) is employed to give motion to a conical drum, a, on the surface of which a spiral path, or groove, is cut the two are so arranged, that on first starting, the chain acts on the small end of the drum, thus exerting a slight leverage; but as the spring uncoils and winds up the chain on its surface, it acts on the larger end of the drum; thus exerting greater leverage. This mechanism thus introduces an equal movement of the fusee a, compensating for the unequal one of the barrel containing the spring. The velocity of the shaft d is made to vary as required: a wheel, $a\ a$, fig. 10, supported on the vertical shaft b, gives motion to the wheel c, the natural roughness of the surfaces creating sufficient hold between them, the shaft d is capable of being moved laterally by means of a screw. the nearer c is placed to the centre e of the wheel $a\ a$, the slower is its motion, and *vice versâ* Two different motions can be given by the revolution of one wheel or shaft. Thus in fig 11, let $a\ a$ be a cylinder revolving in an inclined position on the bearing c, it is desired to make this revolve at a slow speed in one direction, while the internal shaft $b\ b$ is to revolve at a high speed in the contrary direction a bevel-wheel, $e\ e$, is made to revolve by the handle m; it works into a slightly bevelled wheel, d, placed at the end of the shaft $b\ b$; the other end of e works into the face-wheel f, the two motions are thus effected: as thus arranged, the mechanism is that used in a patent "rice-cleaning machine" In the patent "cask-cleaning machine" (fig. 12) two motions are obtained. Each cask is placed in an iron frame or cradle, which revolves within another cradle; while the outer frame makes one revolution in the direction of its length, the inner cradle revolves at right angles to the outer; the revolutions of the inner cradle are regulated by an eccentric placed on the shaft, [illegible] a lever and ratchet fixed on its axis; the in[illegible] revolution for every twenty of the outer. A chain of a peculiar construction is attached to a plug placed in the bung-hole, and by the double action above described, this traverses the whole of the interior surface of the cask A varying motion is produced in a patent flax-machine. To effect a certain purpose, the two rollers $a\ a$, fig. 13, are required to advance and recede from each other. This desideratum is thus obtained:—The bearings $b\ b$, on which the rollers revolve, are made so as to slide easily on slotted bars, $c\ c$; a cross-head, e, which has a vertical reciprocating, or up-and-down motion given to it by the rod f, has two links, $g\ g$, fastened at each end, these links are passed round the ends $d\ d$ of the shafts of the rollers a, a; the links g are made to incline as in the sketch Suppose f to be moved upwards, the cross-head e and links $g\ g$ partake of the motion; as the space between the links thus increases, the bearings $b\ b$ slide outwards on $c\ c$. The fullest extent they can be separated is clearly equal to the extent between the centres of the links at their widest part; on the rod f descending, the space between the centre of the links decreases, and the bearings $b\ b$ move inwards and approach each other. In the "warp-mill" used in cotton-factories, the yarn is laid regularly on the mill by a varying motion, thus $a\ a\ a\ a$, fig. 14, is the frame on which the yarn is to be regularly laid: it is made to revolve by a strap passing round the pulleys b and c, the latter being worked by the crank-handle c'; the full bobbins containing the yarn are made to revolve horizontally on wires or rods in the frame $e\ e$; the threads pass from each through eye-holes in g this moves up and down on the vertical part to which it is attached; a cord passing round the frame-spindle b, and over pulleys to g, by the revolution of the spindle b, gives the required up-and-down motion of g. The yarn from the rollers h, h, of a cotton-slubbing frame, fig. 15, is laid evenly on the bobbins b, b, which revolve on the spindles c, c; the

Fig. 12.

yarn is delivered to the bobbins at x, passing from the rollers through the hollow leg of the flyer a a, the bobbins rest loosely on the copping rail f f this rail is made . . . all by . . . ad t . thus making the bobbins pass up and down on the spindles c, c, and opposite the "finger" r, thus each part of the bobbin is presented to the delivery-finger at r. An intermittent motion is frequently desiderated in machines. In fig 16 we show a simple method of

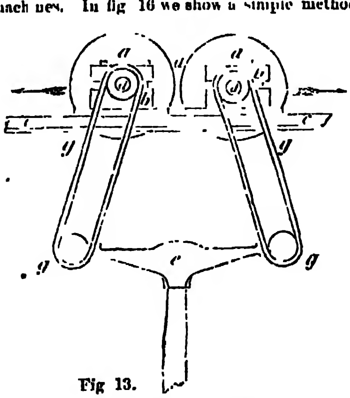

Fig 13.

effecting this a ratchet, a c, is moved one tooth forward each time the wheel b revolves, the projecting tooth c catching one of those of the ratchet. It is obvious that by arranging the relative velocity and size of the wheel and ratchet, and the number of teeth, the ratchet a a may make a certain number of revolutions in any desired time An intermittent motion required in the patent flax-heckling machine is produced as follows --A shaft attached to the ratchet-wheel h h, fig 17, is required to revolve only a certain portion at stated intervals; a cam, a, gives motion to a lever, b, the centre of motion of which is at c; at the end, d, a vertical rod, e, is connected at its upper end to the bell-crank lever f g i, the centre of which, g, is firmly secured to the ratchet-wheel h h; there is a catch placed at i, which takes hold of the projections of the wheel h h; as the lever b rises, the rod e causes f to rise, this makes the catch i slide over the surface of each tooth on the wheel h h, on the lever b falling, f is pulled downwards, and the catch at i taking hold of the p . . . , causes the wheel h h and its shaft to move . . . certain portion of its revolution An intermittent motion is often used in looms for weaving cloth by power. As the cloth is woven, it is wound upon a roller, called a "cloth-beam;" in order that the cloth may be taken up by this beam just as fast as it is produced, and no faster, it is necessary to make it revolve at a certain speed . this is effected by mechanism somewhat resembling the above contrivance A cam, or wiper, placed on the central shaft of the loom, gives an alternating motion to a lever: this acts by the intervention of another lever, furnished with a catch at its upper end, upon a faced ratchet-wheel, somewhat like the crown wheel of a watch, the shaft of the ratchet-wheel has an endless screw at one end, working into a toothed wheel placed on the end of the cloth-beam By this mechanism the cloth-beam is turned round at certain intervals, depending on the velocity of the shaft on which the cam is placed, which moves . . levers, and as this central shaft is connected with the cloth-producing motions of the loom, it is evident that the motion of the cloth-beam will be in direct ratio to the speed at which the cloth is produced. In practice, however, a slight variation exists; to counteract which, various ingenious devices have been brought out Another simple method of giving an intermittent motion may here be noticed. In a machine called the "flax-heckling machine" it is necessary

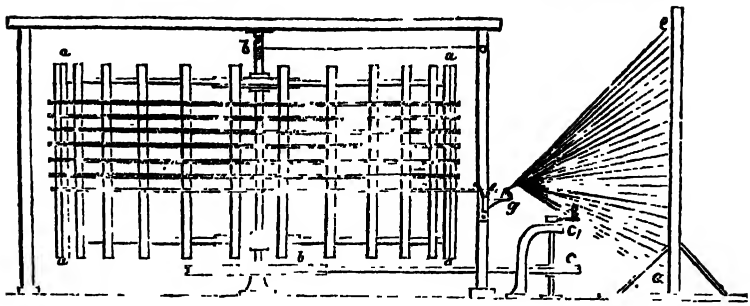

Fig. 14

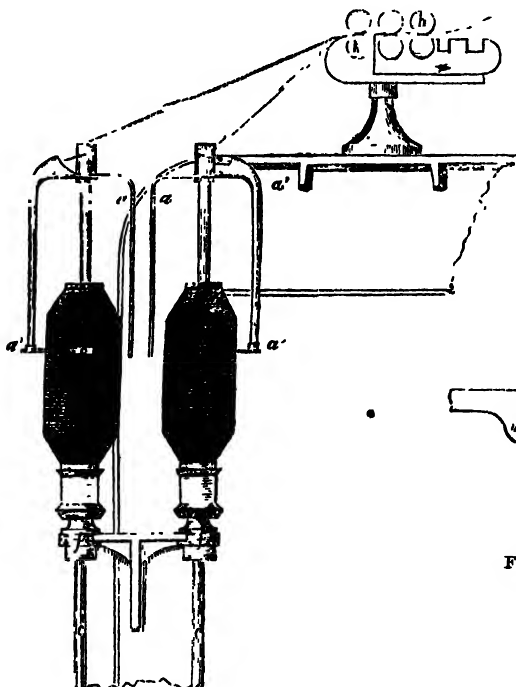

Fig 15.

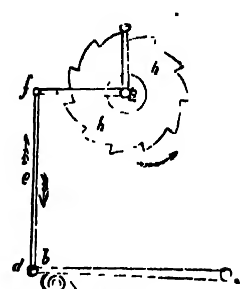

Fig. 17.

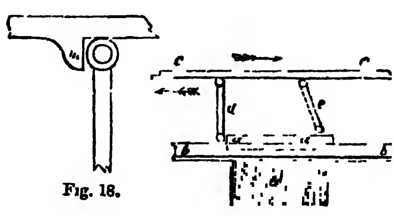

Fig. 18.

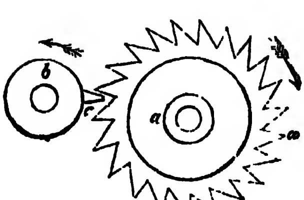

Fig. 16.

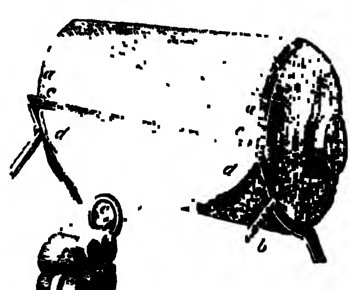

Fig. 19.

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that a contrivance called a "holder" should be moved along bars placed above the main cylinder at certain intervals. In fig. 18 let *a a* be the holder, and *a'* the suspended flax; *b b* the bars on which *a a* is supported; it is desired to move *a a* along *b b* at certain stated intervals: let *c c* be a light bar, parallel to *b b*, but capable of lateral movement in two directions, as shown by the arrows; from this bar let fingers *d* be suspended at intervals, and movable on joints, but provided with catches, as *m*, which will prevent the fingers moving in any other direction but one; on moving *c c* towards the left, the finger will slide over the top of *a a*, as seen by the dotted lines at *e*; but on reaching a certain part it will drop perpendicularly at the end of *a a*; the motion of the bar *c c* is now changed, and moving towards the right, the finger *d* prevented from moving in the wrong direction by the catch *m*; the holder *a a* is thus necessarily moved along *b b*. By modifying the speed of the bar *c c*, and the length of its movement right and left, and the number and distance from each other of the fingers, the holders may be moved along at any desired ratio. An alternating motion is obtained by the revolution of a crank, connected with a "doffer-knife," *c c*, by the side rods *b*, *b*, fig. 19 (the crank is not shown), of the "cotton-carding engine," the doffing cylinder of which is shown at *a a* the cotton filaments caught on the card-teeth on the surface of *a a* are stripped off by the doffer-knife *c c* (which has a quick up-and-down motion), in the shape of a beautiful light fleece, *d d*; this is contracted and passed through a trumpet-mouthed orifice, *e*, and passing through rollers, *f*, is placed in a tin

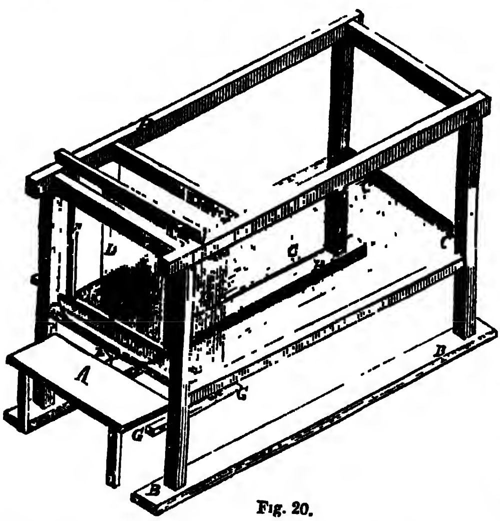

Fig. 20.

can below *a*. The alternating motion of the threads in a loom is obtained by pressing alternately on heddles *G*, *G*, fig. 20. In weaving, one half of the horizontally stretched threads or yarns, *C C*, are required to be lifted up: each alternate thread is passed through between the loops of the threads of the healds *D D*, these being suspended from the top of the frame, and attached at the foot to the heddles; on moving each of these alternately, thereby depressing its heddles, it is evident that the threads passing through the loops will be moved out of the line of the others. In fig. 21 we illustrate the mechanism known as the "mangle-wheel motion," by which an alternating movement is given to a pulley, *a a a*, imparting motion

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to the driving-belt *b c*, first in one direction, as shown by the arrow *b*, and then in the opposite, as at *c*. The pulley *a a a* has a double circular rack, *d d d*, the teeth of which are continued all round, as shown by the dotted lines *e e f*. The stud on which the pinion *h*

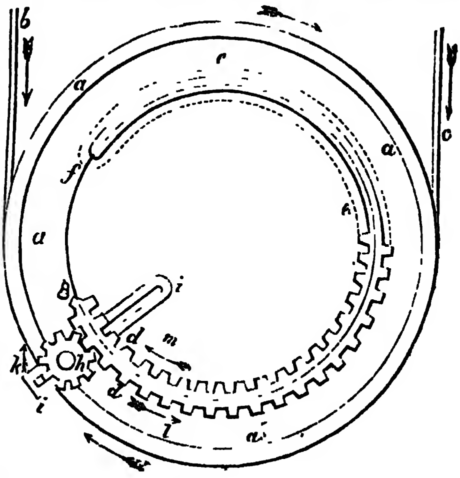


Fig 21.

revolves is allowed to move in the slot *i i*. Suppose the pinion *h* to have a continuous motion imparted to it in the direction of the arrow *k*; in the position in which it is shown in the drawing it would cause the circular rack *d* to move in the direction of the arrow *l*, but on the point *g* of the rack coming up to the teeth of the pinion *h*, the stud of the pinion would be forced to slide along the slot *i i*, till the pinion began to engage with the inner teeth of the rack, when the rack would be made to move in the direction of the arrow *m*, and the belt *c* would move in the direction of the arrow *c*. But when the rack would be brought round till the point *f* come in contact with the pinion, the pinion would slide in the slot *i i* till it engaged the outside teeth of the rack, which would then move in the direction of the arrow *l*, as before. A circular motion is changed into a reciprocating by what is called the rack-and-pinion. Thus in fig. 22 *a a* is the horizontal rack, the upper part of which is provided with teeth: the teeth of the pinion *b* work into these, and cause the bar to be moved horizontally; by turning the engraving, so as to make *a a* vertical, the method of making the circular motion of *b* impart a vertical one to *a a* is at once obvious. By giving the motion in the first place to the rack, it is clear that the wheel *b* will have a circular motion An intermittent circular motion is made to impart an inter-

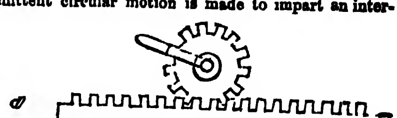


Fig. 22.

mittent horizontal one as follows: Suppose *a a*, figs. 23 and 24, to be part of the holder-frame of a flax-heck-

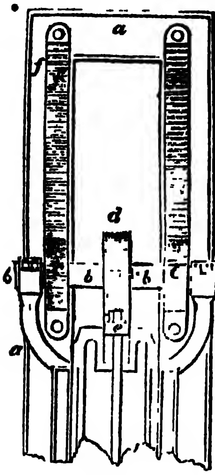


Fig. 23.

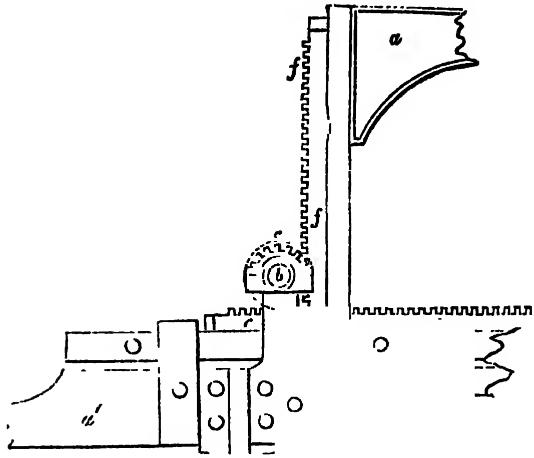


Fig 24.

ling machine; on each side of this, vertical racks, *f*, *f*, are placed, small pinions, *c*, *c*, revolving in bearings, *b*, *b*, work into the teeth of these, the shaft of the pinions carries a toothed wheel, *d*, in its centre; this works into the teeth of a horizontal rack, this forming part of the finger-bar which moves the holders. On the table *a a* rising, the pinions *c*, *c* are made to revolve by coming in contact with the teeth of the racks, *f*, *f*, the wheel *d* partakes of the motion of *c c*, and in its turn moves the rack *e* and the finger-bar to which it is attached. In this piece of mechanism, the changing of a vertical motion into a circular one is seen by the racks *f*, *f* moving the pinions *c*, *c*, and the changing of a circular into a horizontal, by the wheel *d* moving the rack *e*. *To c*[illegible] *circular motion into a continuous* [illegible] The motion used by Watt to change the motion of the beam of his steam-engines to a circular one is another contrivance which may be here noticed it is known as the "sun-and-planet motion." The toothed wheel *c c*, fig 25, is fixed to the end of the fly-wheel shaft, which is to have a continuous circular motion. Another toothed wheel *b*, of equal diameter with *c c* is atttached at its centre to the end of the connecting-rod *a*, and is capable of revolving on its centre. The two wheels are kept in gear by means of a slotted link. An up-and-down

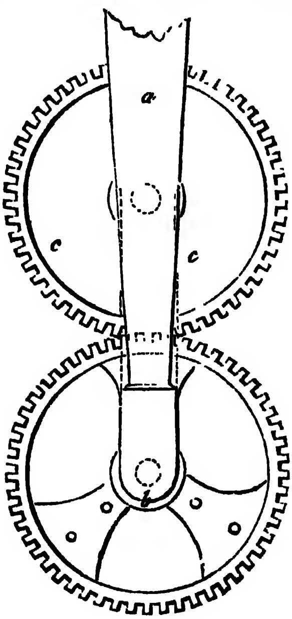


Fig. 25

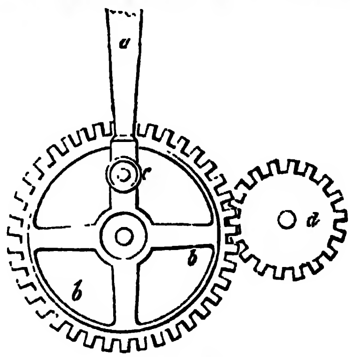


Fig. 26.

stroke of the connecting-rod, or one complete oscillation of the beam, will have made one revolution round the centre of the wheel *c c*; but both wheels being fixed to their centres, the wheel *b* will revolve round *c c*, each tooth coming in contact with those of *c c*. If the two wheels are of equal sizes, the wheel *c c* will make two revolutions for each time the wheel *b* travels round its circumference. Another method of effecting the change of motion under consideration is illustrated in fig 26: let *d* be a toothed wheel fixed on the end of the revolving shaft, and *b* one twice the size gearing into it: let the end of the connecting-rod

…s be attached by a movable joint at c to one of the arms of b, then the reciprocating circular motion of the beam to the end of which the rod a is attached is changed into a continuous circular one at c. In fig.27 we give a method of changing a vibrating motion of a beam $g\,g$ into a rotary one of the fly-wheel $n\,n$. Two sets of teeth, l and m, are formed on the segment, which takes into two pinions placed loosely on the fly-

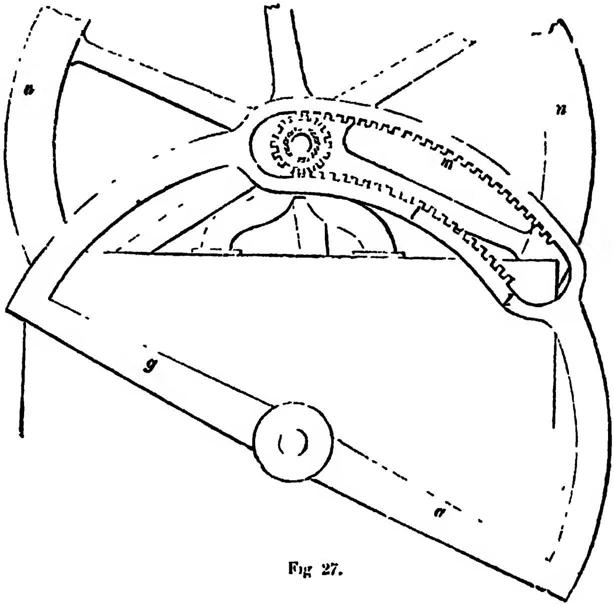
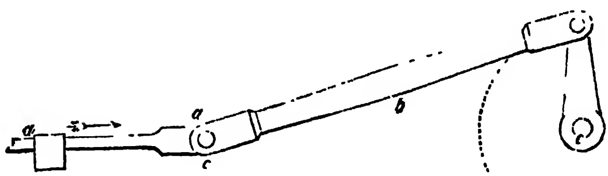


Fig 27.



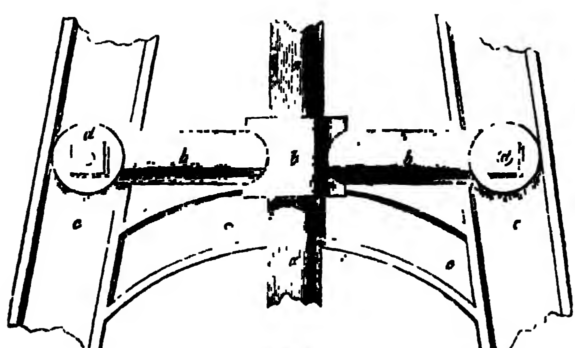


Fig. 29.

wheel shaft, the teeth being in different planes for that object. The pinions have spring-palls attached, which take into the teeth of ratchet-wheels fixed to the shaft. The teeth of these ratchets are set in opposite directions; so that while one pinion is transmitting the motion of *g q* to the main shaft, the other pinion is revolving on the shaft in the reverse direction, and its pall slipping backwards over the teeth of its appropriate ratchet-wheel *To change a reciprocating rectilinear motion into a circular one* —Let *a a*, fig 28, be the piston-rod of a steam engine, moving horizontally in guides, backwards and forwards, as shown by the arrows; a connecting-rod, *b*, moving on the centre *c*, and attached to the crank-pin at *d*, will give the engine known as the "crank overhead." Another modification is given in fig 30. The piston-rod *c* is provided with a cross-head, *d d*, the ends of which are provided with circular parts sliding within a slot in the side framing *a a*, a side view of which is shown in fig. 31. The connecting-rods *e f, e f* are attached by straps and brasses to journals made in the cross-head *d d*, the other ends to two cranks placed beneath the cylinder, which stands on a frame. The method employed by Dr. Cartwright for changing the up-and-down motion of the piston-rod of his steam-engine into a continuous circular one, is shown in fig. 32. The cross-head *d* of the piston-rod *a* has two connecting-rods, *m, m*, jointed at *e, c*, and attached to two cranks,

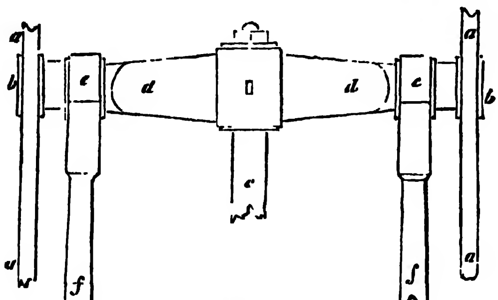


Fig. 30.

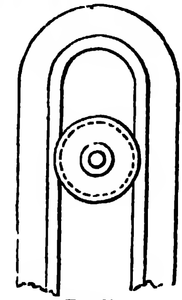


Fig. 31.

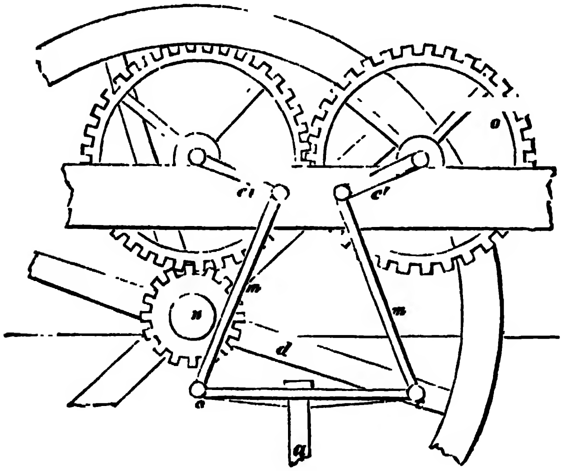


Fig. 32

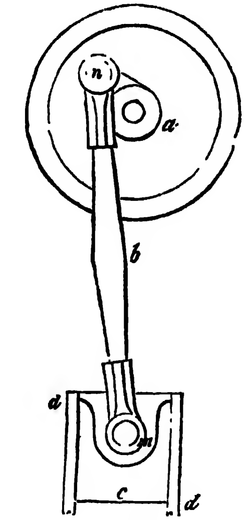


Fig. 33.

shaft *e*, to which the crank is fixed, a continuous circular motion. This is the movement used in steam-engines where the cylinder is laid *horizontally*. In small steam-engines, where the cylinder is vertical and the crank above the cylinder, the piston-rod moves vertically up and down in a guide attached to the framing of the engine. Thus, in fig. 29, *c c c* is part of the framing of the engine, or standard, on the top of which, in a suitable bearing, the crank-shaft revolves; *a a* is the piston-rod, which moves up and down, sliding in the guide *b b*, which is attached to the standard by bolts, *d, d*; the connecting-rod is attached to the end of the piston-rod, and the other to the crank-pin. This modification is that used in the form of high-pressure *c, c'*, fixed to the axis of two toothed wheels. While the piston *a* makes an up-and down stroke, the large wheels make a complete revolution: the rate of motion of the small pinion fixed in the main shaft depends upon the number of teeth in *n* compared with that in *o* *To change a continuous circular motion into a reciprocating rectilinear one.*—This is the motion used in mills where stampers are employed. Again, suppose *c*, fig. 33, to be a stamp or punch, moving vertically in a fixed guide, *d d*; by attaching a connecting-rod to the end *m*, and its other extremity to a pin. *n*, placed in the face of the wheel *a*, at a certain distance from its centre, the stamp or punch *c* will have an alternate movement up and down, while that of

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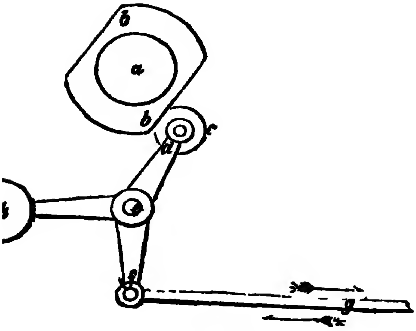

Fig. 35.

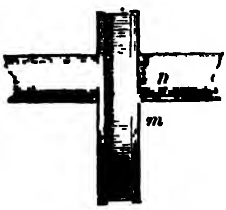

Fig. 37.

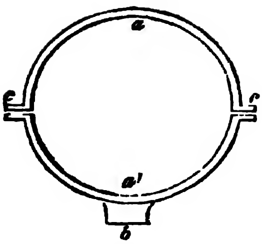

Fig. 38.

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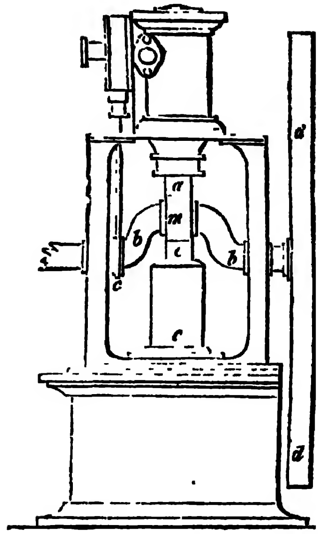


Fig. 36.

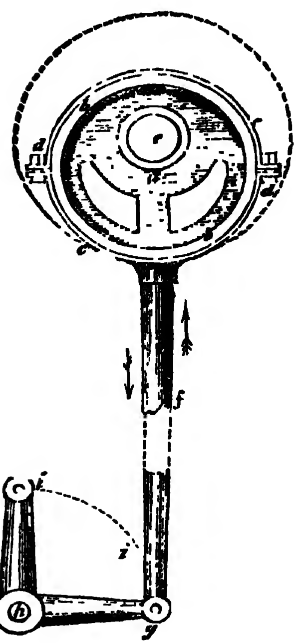


Fig 39.

a is a continuous circular one. The continuous circular motion of the cam *b b*, fig. 35, revolving on the centre *a*, gives reciprocating motion to the rod *g*; the edge of the cam works in contact with the friction-wheel *c*, attached to the end *d* of the bell-crank lever *d e f*, vibrating on the centre *e*; a counter-weight (*h*) gives regularity to the motion. This contrivance is used in the "expansion-gear" of marine engines. In the "steam-pump," an elevation of which is shown in fig. 36, the reciprocating motion of the piston-rod *a* gives a rotatory motion to the crank *b b*, fly-wheel *d d*, and eccentric *c*; by the movement of the crank in a longitudinal, horizontal, slotted cross-head *m*, the reciprocating motion of the pump-rod *c* is obtained; by the movement of the piston-rod *a*, the circular motion of the fly-wheel is obtained, applicable to driving machinery, while at the same time the necessary motion of the pump-rod is derived. If the rack in fig 22 had only a few teeth on its face, and the pinion *b* with teeth only on half of its circumference, then the continuous circular motion of *b* would give a reciprocating up-and-down motion to the beam on which the rack might be fastened: in this case the rack and beam are supposed to be vertical. On the teeth of *b* catching those of the rack, the beam would be lifted up; but on the toothless portion of *b* presenting itself, the beam would fall, ready to be moved upon the toothed portion of *b* again coming round If the rack were horizontal, as soon as the teeth of *b* passed round, the rack might be pulled back again by a weight and cord passing over pulleys. In this case the power of *b* would be exerted in moving the rack and beam, and also the weight. *To change a continuous circular motion into a reciprocating circular one.*—The contrivance usually adopted for this purpose is that known as the "eccentric." This is merely a circular disc of metal firmly fastened on a revolving shaft; instead, however, of the disc being fixed at its true centre on the shaft, its centre of motion is placed at

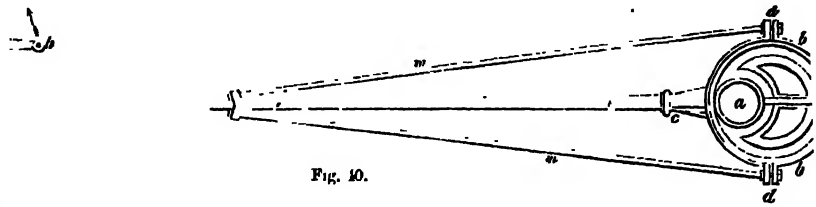


Fig. 10.

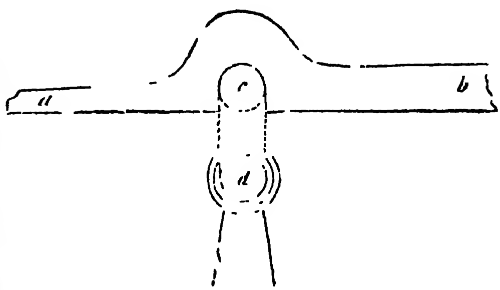


Fig. 11.

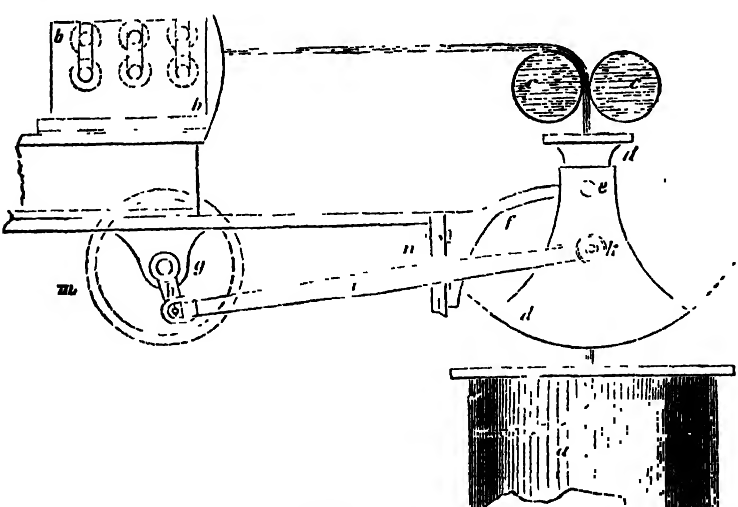


Fig. 12

some distance from it. Thus, suppose fig. 37 to represent the circular disc, the true centre of which is at *m*, the centre of motion is placed at *n*. The edge of the disc or circumference is not plain, but is turned so as to have projections at each side; thus forming a kind of groove. This groove admits of the eccentric rings or hoops *a*, *a'*, fig. 38, being passed round: the rings are made in two halves, and secured, after being passed round the disc, by bolts at the projecting snugs *c c*; the eccentric rod is generally screwed into the part *b*. A form of eccentric with hoop and rod is shown in fig 39, where *a b b* is the eccentric disc, its true centre being at *a*, its centre of motion at *e*; the rings *c c* are secured by the bolts *d d*, the rod *f* is connected to the bell-crank *h g* at *g*; the centre of vibration is at *h*; the end *i* describes a portion of a circle; a rod jointed at *i* will have a reciprocating motion, the disc *a* revolves easily within the rings *c c*, which are kept well lubricated to reduce the friction: the ring and rod *f* thus partake of the motion of the disc, and an alternate reciprocating motion of the rod *f* is produced. We give in fig. 40 a form of eccentric gear adopted in large steam-engines. *a* is the centre of motion, *b b* the rings, bolted together at *d d*; *c c c* the rod, strengthened by lateral stays (*m*, *m*), *f* the pin of the bell-crank vibrating at *g*, a vertical rod jointed at the other pin (*h*) will have a reciprocating motion. In fig 41 an enlarged view is given of that part of the eccentric rod which is attached to the crank-pin: a slot with circular end (*c*) passes over the pin *d* of the crank; when the motion of the eccentric rod *b* is not required to give motion to the lever *d*, the attendant takes hold of the end *a* of the connecting-rod, and lifts it off the crank-pin; it is then allowed to slide along a portion of the rod *b* near *a*, or the end *a* is tied to a rope attached to any convenient part. Another method of converting a continuous circular motion into a reciprocating circular one is shown at fig. 42: a wheel (*m g*) has a crank or lever (*h*) fixed to the end of its shaft, a connecting rod (*i*) is attached by a joint at *k* to a trumpet-mouthed deliverer (*d d*) vibrating at *e* on the standard *f*. the part *d d* has a circular reciprocating motion, as seen by the dotted line *n n*. The object of this contrivance is to deliver the long "sliver" or riband of cotton fibres passing through the rollers *b b*, *c c*, to the tin can, part of which is shown at *a*, in a regular layer. *To change a reciprocating circular motion into a reciprocating rectilinear one.*—In Newcomen and Watt's single-acting steam-engine, where the beam was only pulled down by the pressure of the atmosphere acting on its piston, the weight of pump-gear at the other end raising it again, the means adopted for the straight up-and-down motion of the piston-rod, while the end of the beam moved in a circle, was very simple: we show it in fig. 43. To the top of the piston-rod *d* a chain *c* was attached; this passed over the circular end *b b* of the beam *a a*, and was fastened to the upper end. The sector *b b* was described from *m*, the centre of the beam; on the beam oscillating, the chain coiled and uncoiled on the sector, the line of the piston-rod forming a tangent to the arc *b b*. This contrivance was only available where the piston exercised a pulling motion; but where the impulse of steam was given not only to depress but to raise the piston, another contrivance was obviously necessary. The genius of Watt, the great improver of the steam-engine, was equal to the difficulty of the task; and the beautiful and philosophical mechanism known as the "parallel motion" was the result of his attention to the subject. The subjoined diagram illustrates the motion. Let *a b*, fig. 44, be half of the working beam, vibrating on the centre *a*, let *c* be a point half-way between *a* and *b*, a rod (*d m*) called the "radius-bar," equal in length to *a c* or *c b*, is fixed with a movable joint to a point at *m*, and at the other to the end of a link (*c d*), movable on pins at *c* and *d*. Suppose the beam *a b* to oscillate on its axis *a*, the point *c* will describe a portion of a circle of which *a* is the centre, and at the same time the point *d* will move in a circle of which the centre is *m*: the result of these movements is, that the middle point *h* of the link *c d* moves in a straight line,—at all events, so nearly that the deviation in practice is of no moment. This movement, so far described, gives an explanation of the principle; but the movement as carried out in practice is made complete by the following additions. Another link (*b e*), equal in length to *c d*, is attached at *b* to the end of the beam by a movable joint or stud; "a parallel bar" (*s*), parallel to the beam *a b*, joins *c d* and *e b* by movable joints at *d* and *e*; the point *e* will move in a straight vertical line *e*, *b*; the air-pump rod is attached to the point *h*, and the piston-rod to the point *e*. The form of parallel motion used in marine engines is given in fig. 45; where *a b* is the

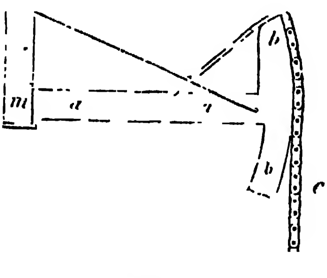


Fig. 43.

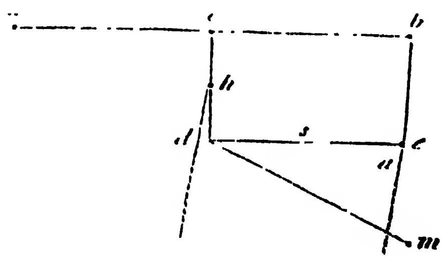


Fig. 44.

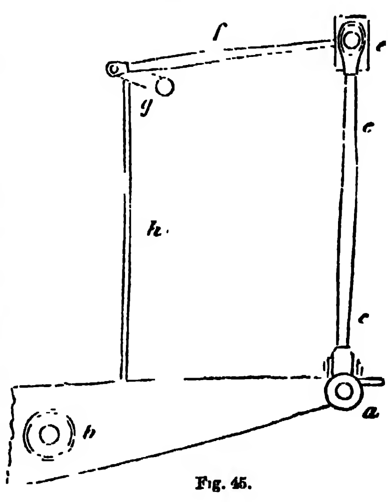


Fig. 45.

beam, which is placed at the foot of the cylinder and framing; *c c*, the side lever, attached to the end of the piston cross-head *e*; *f*, the "parallel bar;" *g*, the "radius bar;" *h*, a rod connected with the beam and radius-bar. In high-pressure steam-engines, the piston-rod is made to move in a straight line by pulleys attached at each end of the piston cross-head, and sliding between two vertical guides: thus, in fig. 46 *a* is the piston-rod, *d* the pulleys, *c* the guides, *b* the connecting-rod. The movement known as "White's parallel motion" is also available for this purpose. In fig. 47, let *a a* be a large annular toothed wheel fixed at the points *b b* to a framing; let *e e* be the piston-rod, *d* the crank-pin, which is fixed to the circumference of a small toothed wheel (*c c*), the vertical movement of the piston-rod causes the wheel *a a* to roll within the inner circumference of the annular wheel *a a a*: if the diameter of the wheel *c c* is one-half of that of the wheel *a a*, or equal to its radius, then the point *d* will describe a straight line in the

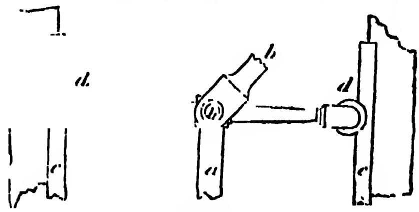


Fig. 46.

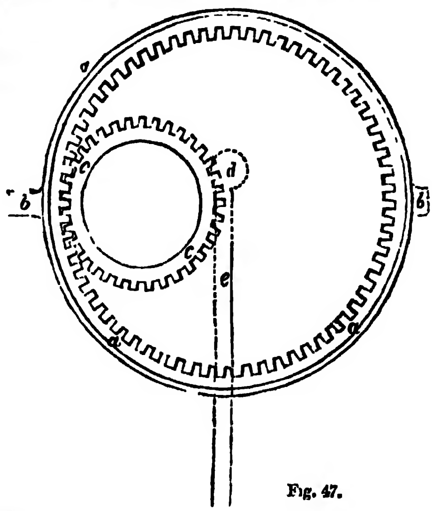


Fig. 47.

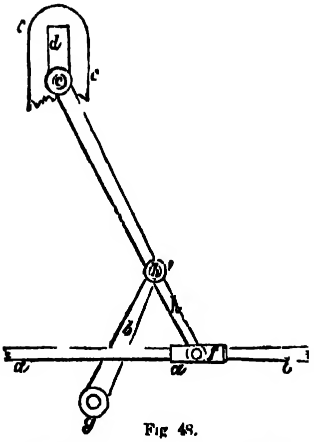


Fig 48.

Fig. 49.

direction *d e*; if the proportions are different from the above, the point *d* will generally describe a curve known as the hypocycloid. A recently patented "parallel motion," applicable to horizontal steam-[illegible] fig. 49. [illegible]

of which moves up and down the slot *d*, at *h'* another lever (*h*) is attached, oscillating on the centre *g*. A vibrating motion given to the pinion *b*, fig 22. will change its circular reciprocating motion to a reciprocating rectilinear one, by making the rack move up and down. We have now to notice the contrivances adopted for *regulating* motion. These are generally applied in cases where a movement is not uniform: thus, in the use of a crank, there are certain points where the connecting-rod has no influence in producing circular motion of the shaft to which it is attached. In marine and locomotive engines, where no fly-wheel is used, two engines work together, but the cranks are placed at right angles to each other; thus, while one crank is at its dead point, the other is receiving the full impulse of the engine. In fig. 49 *a a* is the main crank-shaft, on which the paddles or driving-wheels are fixed; *c c* a crank, *d d* a similar one shown in dotted lines, but at right angles to *c c*; that is, the end of it is only seen, as at the double dotted lines at *d*. In Mr. Brunel's "oblique engine," two cylinders are employed to give motion to one crank. The cylinders are inclined to each other at an angle of 60°; thus the framing takes the form of an equilateral triangle, the cylinders rest on the side, and the main shaft works on bearings placed on the apex of the triangle. "The piston-rod is preserved in its rectilineal course by metal rollers running upon guide-plates. . . . . When the piston of one of the cylinders is at half-stroke, the piston of the other is at the termination of its stroke, or nearly so; and thus the irregularities of the one cylinder partly counteract the irregularities of the other." We may here notice the ingenious contrivance adopted by Mr. Buckle, and termed a "pneumatic equalizer." "It acts upon the principle of causing the engine to drag up a piston against the pressure of the atmosphere, when the energy of the moving power is above the average; the power thus consumed being returned to the engine by the atmosphere forcing down the piston, when the energy of the moving power is below the average." The fusee of a watch, described and illustrated in fig. 9, is another method of regulating motion. The "steam-engine governor" is another important regu-

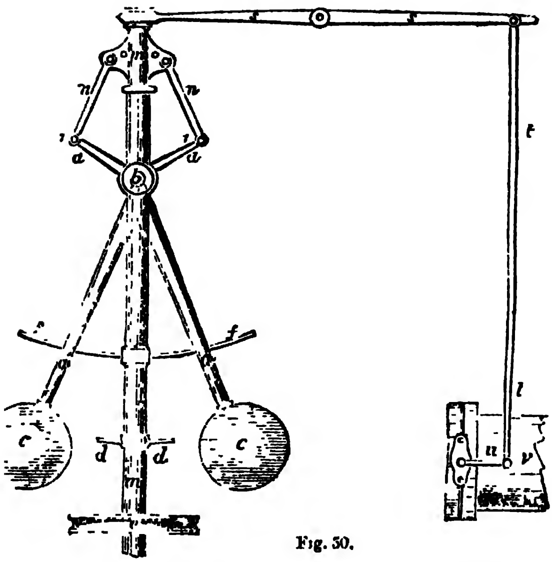


Fig. 50.

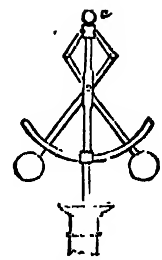


Fig. 51.

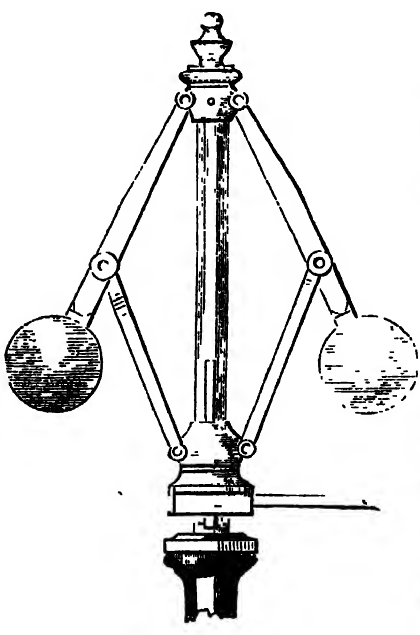


Fig. 52.

lator. In fig. 50 we give an elevation of this beautiful piece of mechanism m m is a vertical rod revolving in bearings at top and bottom, and put in motion by the pulley e, two heavy balls (c, c) are fastened to the ends of bent levers (a a, a' a'), the centre of which is at b, these levers passing through a slot made in the rod m at b, and secured by a pin passing through both sides of this and the two levers; the levers thus turning on the pin b can be made to recede from, or be drawn towards each other, like the arms of a pair of pincers; the ends a', a' are attached to small links (n, n), joined to projecting snugs (o, o) by small studs or pins; to keep the levers a a in their true position, they are made to move within guides (f, f); a stop (d d) is sometimes fastened to the rod m, having circular parts cut out at the extremities. When the "governor" is at rest, the balls rest on this stop; on the rod being put in motion by the pulley e, the centrifugal force generated causes the balls to fly outwards, thus opening the extent between a a, and, on the contrary, lessening the distance between a' a'; this acting upon the links n, n causes the projecting snugs and attached ring to slide upwards on the rod m; this raises the end of the lever s s, depresses the other end and the lever t t, thus turning the valve attached to the lever u in the steam-pipe v. The action thus described takes place whenever the engine revolving too fast, causes the governor-balls to fly out, and shuts in a corresponding degree the valve in the steam-pipe; thus less steam is admitted to the cylinder, the engine necessarily goes slower, the governor revolves at a less speed, the centrifugal force is lessened, the balls fall inwards towards the rod m, the ring m o o slides downwards, the lever t t is pulled upwards, and more steam is admitted to the cylinder by the opening of the

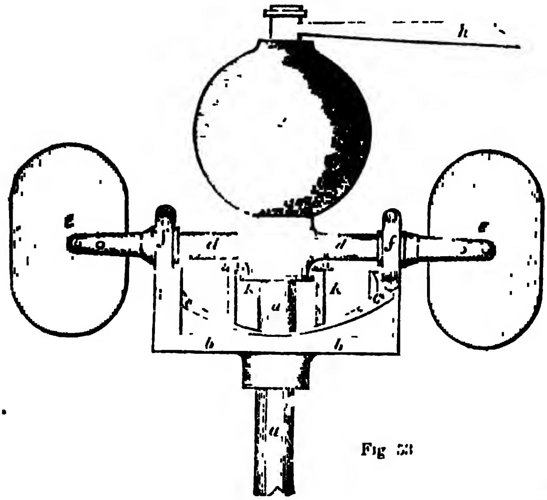


Fig 53

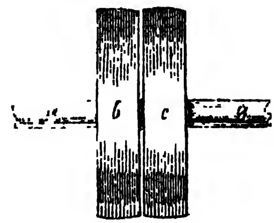


Fig. 54.

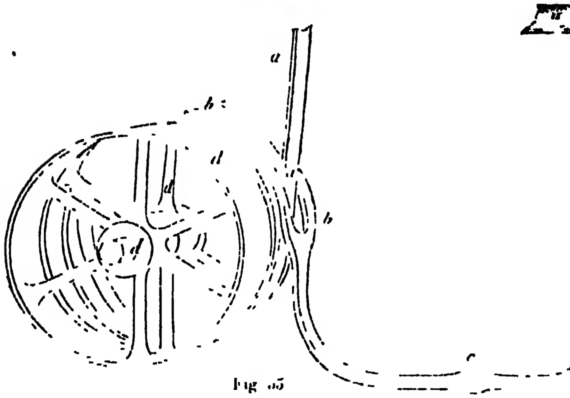


Fig 55

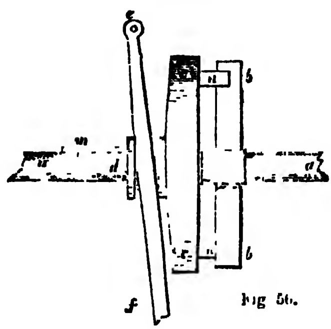


Fig 56.

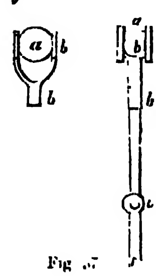


Fig 57

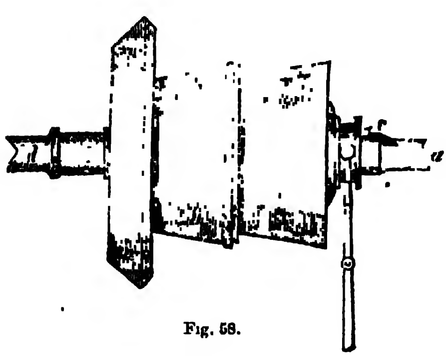


Fig. 58.

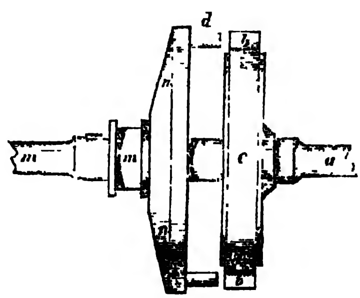


Fig. 59.

valve; the speed of the engine is again accelerated, again to be checked if too high, and so on; thus keeping the engine at a nearly regular speed. This is one of the beautiful self-acting motions which make machines adjust their various movements almost with creative intelligence, and examples of which will be found in numerous departments of practical machinery. In figs. 51 and 52 we give other forms of governors. A form of governor in which the inclined plane is a noticeable feature is shown in fig. 53, the vertical spindle *a* turns on an upright bearing, and is made to revolve in the ordinary manner, a disc (*b b*) having two circular inclined planes (*c*, *c*) on the outer edges, is firmly keyed on to the spindle *a*; a cross head (*d d*), having wings or fans (*e*, *e*) at its extremities, is mounted on the spindle *a*, so as to have a vertical sliding motion up the spindle, and yet capable of revolving; friction pulleys (*f*, *f*) run on the circular inclined planes or edges of the disc *b b*, a heavy ball (*g*) is carried by and rests on the cross-head *d*, this keeps the rollers *f*, *f* at the lowest point of the inclined planes; the end of the throttle-valve lever *h* rests upon the top edge of the ball: this moving up or down, according to the speed of the engine, shuts or opens the steam-valve, and thus regulates the supply of steam to the cylinder. The operation of the governor is as follows.—On the engine starting, the spindle *a* begins to rotate, and carries round the cross-head *d*, as, however, the speed increases, the resistance of air to the fans *e*, *e* retards its progress, the wheels *f*, *f* consequently raise up the circular inclined plane, and thereby raise the ball *g* and the lever *h*. In order to prevent the wheels being carried over the top of the planes, stop-pieces are there placed, or a lip (*j*) may be made at the lower end of the ball or weight *g*, and two pins (*k*, *k*) screwed into the disc *b b*; the pins are furnished with adjustable buttons, the lip *j* will come in contact with these, and prevent the wheels from rising too high. The fly-wheel is a contrivance for accumulating power. Thus the power expended on it is given out while the crank is at its dead points. Buckle's pneumatic equalizer is also another method of accumulating power. A familiar example is met with in the coining and embossing machine, a quick running screw works in a vertical frame; at the lower end a punch or die is placed, beneath this, on a small table, the coin to be struck, or the article to be embossed, is placed; to the upper end of the screw a horizontal lever with long arms is firmly fixed; heavy balls or weights are fixed at the extremities of the lever, the workman whirls the lever and weights rapidly round, the power thus accumulated is given out, in making the screw descend with great force. A modification of this machine is used in making the slits in steel pens, and in punching the eyes of needles. ENGAGING AND DISENGAGING OF MACHINERY IN MOTION.—The couplings, which we have already described, are contrivances by which shafts are not only connected together, but admit of their disconnection when required. It is obvious, however, that this can only be attained when the shafts are at rest. In almost every variety of machine it is necessary to have means whereby the motion from the prime mover can be applied to, and as readily taken from, the actuated machine, and this without stopping or altering the power. In the ingenious and complicated machines employed in the cotton manufacture, it is matter of surprise to the uninitiated how easily the attendants can set one part in motion or stop it; and this without altering in any way the movement of the other parts or of the shafts which communicate the motion from the prime mover. The simplest, and certainly the most perfect contrivance for engaging and disengaging machinery, is that termed the "fast-and-loose pulley." Let *a a*, fig 54, be the shaft to which the motion is to be applied when required, a pulley (*b*) revolving loosely on the shaft; the pulley *c* is of the same diameter, and is fixed on the shaft by means of a key; when the belt from the driving-pulley is running on *b*, the shaft obtains no motion, as the pulley freely revolves on it; but on the belt being shifted by hand to the pulley *c*, the shaft begins to revolve. This movement is almost universally used in machines of every kind. Simple as it appears, it is so effective that the start is effected with little or no shock; a desideratum the value of which may be known, when we state that before its introduction many machines could not be driven by continuous power. In many cases the belt is moved from one pulley to another by hand; this is, however, attended with some danger, as the hand of the operator is sometimes drawn in by the revolving wheel. A method by which the movement is effected is seen in fig. 55, where *d*, *d* are the pulleys, and *a* the belt; the belt moves within the forked end of a lever (*b b*) the centre of which is at *c*; by moving this lever from side to side, it is obvious that the belt can be easily moved from pulley to pulley. Another method sometimes used is shown in fig. 56, where *a* is the shaft, *c c* a pulley driven by a belt from the moving power, and revolving freely on the shaft; a clutch, *d*, is attached to the side of the pulley *c c*; a lever, movable at *e*, lies on the upper side of the clutch; a gland, or cross-piece (*b b*), is fixed to the shaft; and cross-pieces (*n*, *n*) are placed near the circumference of *c c*; by moving the lever *f*, the clutch and pulley are moved along the shaft till the projecting pieces *n*, *n* catch the gland *b b*, the shaft *a a* is thus set in motion. Instead of having the lever, as in fig. 55, movable at a centre (*c*), it is sometimes made with a fork, as at *b b*, fig. 57 this embraces the coupling *a*, yet allows it to revolve freely the centre is at *c*. To avoid the shock in setting shafts too suddenly in motion, various plans are used, the fast-and-loose pulley is a very effective plan, but it is not always convenient to apply it. The following is a method of effecting the engagement and disengagement of machinery without incurring a shock, it is termed the "friction-cones." On the end of the shaft *a*, fig. 58, a clutch and conical piece are fixed, capable of longitudinal motion on the shaft *a*, but made to revolve with it; this is effected by having a key (*c*) fixed on the shaft, along which the clutch moves in a slot made in its interior surface. Suppose *m* to be the wheel, fixed on the end of the main shaft *d*, provided with a conical piece (*e*), the interior of which receives the exterior cone *b*; by means of the lever the clutch and cone *b* is moved along the shaft; on *b* entering *e*, the friction created is sufficient to move the shaft *d* and wheel *m*. When in gear, they are held by means of a screw or by a weight. On either of the shafts *a* or *d* being stopped, the cones fall out of gear, and the connection is stopped. Another mode adopted for obviating the shock in engaging and disengaging machinery is illustrated in fig. 59. A pulley is fixed on the end of the shaft *a*; this being tightly embraced by a friction-band (*c*), projecting snugs (*b*, *b*) are placed on the periphery of the band; a clutch and cross-piece (*n n*) on the shaft *m* has projections, or prongs (*d*, *d*), on the clutch being moved along the shaft *m* by the lever, the prongs *d*, *d* catch the snugs *b*, *b* on the friction-band; this slips round on the pulley, till the friction becomes equal to the resistance, and the shaft gradually attains the

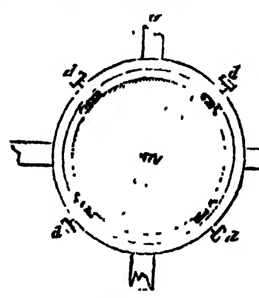


Fig. 60.

motion of the clutch. A modification of this method is exemplified in the "friction-wheels." Let *a a*, fig. 60, be the pulley or wheel which is capable of being set in and out of gear by any of the methods we have shown; the eye of this is made as large as pos-

able; in the inside of this, small pieces of brass (*c c*) are fixed in such positions that pinching-screws (*d*, *d*), pressing upon them, are placed between the arms of the wheel or pulley. On the shaft to be driven a boss or friction-wheel is accurately turned, so as to fit the eye of the wheel *a a*; by means of the screw *d d*, the brasses *c*, *c* are made to press on the surface of *m*, and are so adjusted that the friction created is equal to the resistance offered by the wheel: as soon as the resistance by any means exceeds this, the wheel *a a* begins to move over the boss *m*, the shaft *m* continues its motion, and the wheel becomes stationary, thus the breakage of the teeth of the wheel or of the pulley is avoided. When machinery is suddenly stopped, or its direction is reversed, as the shaft beginning to turn the wrong way, it is necessary to have some means of stopping the motion of the driving-shaft. A contrivance for effecting this is shown in fig. 61 to the

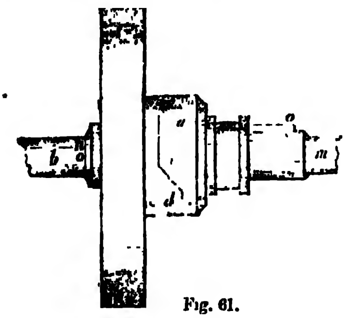


Fig. 61.

clutch *a* on the shaft *m*, and the wheel *c* on the shaft *b*, projections with oblique faces are attached; these exactly fit into each other when in gear; the wheel *c* and clutch *a* are allowed to move on the shafts, the wheel *c* being capable of moving round on it, longitudinal motion, however, being prevented by two pins placed at each end, as at *n n*, the clutch moves longitudinally along the shaft, but cannot revolve thereon by the intervention of the key *o*, as before described. On the clutch *a* being moved along the shaft by a lever, the faces come in contact, and the shaft *m* is moved; on the wheel *a* receiving any increase of speed or pressure, the oblique faces fall out of contact.

MACKEREL, *măk'-e-rel* (Du *mackreel*, from Lat *maculatus*, spotted), a member of the *Scomberidæ*, a family of acanthopterygious fishes, and known by the scientific appellation of *Scomber scomber*, according to the Linnæan system. The generic characters of the mackerel are as follows —Scales on the body small and smooth; vertical fins not bearing scales, two dorsal fins widely separated, some of the posterior rays of the second dorsal and the anal fin free, forming finlets, sides of the tail slightly carinated, one row of small conical teeth in each jaw; the parts of the gill-covers without denticulations or spines, and, lastly, the branchiostegous rays seven in number. Its usual length varies between twelve and sixteen inches; but it is occasionally found in northern seas of even greater size. The nose is pointed, and the under jaw is the longest. The colour of the back above the lateral line is a fine green, traced with rich blue, and marked with broad dark descending lines It is said that the males have these dark transverse bands nearly straight, while the females have them beautifully undulated. The sides and under surface are of a silver-colour traced with brilliant golden tints; altogether, the mackerel is one of the most beautiful of fishes. It was supposed, originally, to be a fish of passage; but there is no doubt that this assertion is untrue, as it is caught nearly the whole year round off the Cornish coast. As an article of food, the mackerel is in great request, and those taken in May and June are said to be superior to those caught later in the year. The fishery is very extensive, and the returns they bring in to the different b[illegible] engaged [illegible]

The most common mode of fishing is by drift-nets, and the method is thus described by Mr. Yarrell:—"The drift-net is twenty feet deep by one hundred and twenty feet long, well corked at the top, but without lead at the bottom. They are made of small fine twine, which is tanned of a reddish-brown colour to preserve it from the action of the sea-water; and it is thereby rendered much more durable. The size of the mesh is about two and a half inches, or rather larger. Twelve, fifteen, or sometimes eighteen of these nets are attached lengthwise by tying along a thick rope, called the drift-rope, and at the ends of each net, to each other. When arranged for depositing in the sea, a large buoy attached to the end of the drift-rope is thrown overboard, the vessel is put before the wind, and as she sails along, the rope, with the nets thus attached, is passed over the stern into the water till the whole of the nets are run out. The nets thus deposited hang suspended in the water perpendicularly, twenty feet deep from the drift-rope, and extending from three-quarters of a mile to a mile, and even a mile and a half, depending on the number of nets belonging to the party or company engaged in fishing together. When the whole of the nets are thus handed out, the drift-rope is shifted from the stern to the bow of the boat, and she rides by it as if at anchor. The benefit gained by the boat's hanging at the end of the drift-rope is, that the net is kept strained in a straight line, which, without this pull upon it, would not be the case. The nets are shot in the evening, and sometimes hauled once during the night, or allowed to remain in the water until the morning. The fish roving in the dark through the water hang in the meshes of the net, which are large enough to admit them beyond the gill-covers and pectoral fins, but not large enough to allow the thickest part of the body to pass through. The nets are thus hauled in:—a capstan on deck is manned, and the drift-rope attached to it; one man stands forward to untie the upper edge of each net from the drift-rope, while others hand in the net with the fish on one side of the vessel, the other being devoted to hauling in the drift-rope The whole of the net in, and the fish secured, the vessel runs back into harbour, or deposits her cargo on board some swifter boat in company, which carries it to the nearest market" The mackerel is also taken by line-fishing, one of the [illegible] small tapering piece of red cl[illegible] (*See* FISHERIES.)

[illegible], in honour of William Maclure, a North-American geologist), in Bot, a gen. of the nat. ord *Moraceæ* The wood of the species *M. tinctoria*, a native of the West Indies and South America, is of a golden-yellow colour, and is much employed in this country and elsewhere as a dyeing agent. It is commonly known as *fustic*, or *old fustic*, to distinguish it from *young fustic*. (*See* RHUS) The fruit is edible. Another species, *M aurantiaca*, supplies the fruit called the *Osage orange*, the juice of which is used by some of the Red Indians as a yellow war-paint.

MACRABIOTICS, *ma-kră-bi-ot'-iks* (Gr *makros*, long, and *bios*, life), is applied to the science of prolonging life. (*See* LONGEVITY.)

MACROPIPER, *ma-kro-pi'-per* (Gr. *makros*, long; Lat. *piper*, pepper), in Bot, a gen of the nat. ord. *Piperaceæ* The species *M methysticum* is the celebrated Ava pepper-shrub, from the rhizome of which the South-Sea islanders prepare an intoxicating drink, called *ava*, or *cava*. The plant has been used medicinally in chronic rheumatism and venereal affections.

MACROURA, *mak rou'-ră* (Gr. *makros*, long; *oura*, tail), in Nat. Hist, the term given to the long-tailed Decapods; as, for instance, the shrimps, prawns, lobsters, &c At the extremity of the tail there is a kind of fin, laterally expanded. This serves to propel the animal through the water by its action, which is that of a vertical stroke

MACTRA, MACTRADÆ, *măk'-tră*, *măk-tră'-de*, a fam. of molluscous animals of the ord. *Conchifera Dimyaria*.

MACULÆ, *măk'-u-le* (Lat., spots), in Ast. are dark spots appearing on the luminous surfaces of the sun and moon, and even some of the planets The solar maculæ are dark spots of an irregular and changeable figure. They are said to have been first observed by Galileo in 1610 in Italy, and Harriot in England, unknown to and independent of each other

French title, originally applied only to female saints and ladies of quality, but which is now common to all married women, of whatever rank or condition. Under the old French monarchy, the daughters of the sovereign received this title; the eldest being simply Madame, the others Madame Elizabeth, &c. More strictly, however, it belonged to the wife of the king's eldest brother, the sister of the king's father or mother, or the eldest daughter of the dauphin, by only one of whom could the title be borne at the same time. Mesdemoiselles was the title of honour borne by the daughters of the king's younger sons, and of his brothers and uncles; the one taking precedence of the others in rank or birth being Mademoiselle.

MADDER. (*See* RUBIA.)

MADHOUSE. (*See* LUNATIC ASYLUM.)

MADNESS. (*See* LUNACY, INSANITY.)

MADONNA, *mă-don'-nă* (Ital., my lady), a word originally used in Italy, like Madame in France, as a title of honour and dignity; but now more particularly applied to the Virgin Mary, as, in other languages, she is called Our Lady. It is also applied to a number of celebrated pictures in which the Virgin forms the sole or principal object; as the Madonna di San Sisto, of Raffaelle, now in the picture-gallery at Dresden.

MADREPORE, *măd'-re-pore*, a term first employed by Imperati to designate a genus of coral-building animals, in which the calcareous axis has its whole surface beset with small lamellate and stellate depressions. Etymologically, the word is a compound of the French *madré*, spotted, and the Latin *porus*, a pore. The genus was adopted by Linnæus, who ranked it among his *Vermes Zoophyta*, and characterized it as follows:— "Animal resembling a medusa; *coral* with lamellate star-shaped cavities."

MADRIGAL, *măd'-re-găl* (Sp., Fr.), is a kind of short poem, having generally fewer verses than the sonnet, and admitting of greater liberty in the arrangement of the rhymes and verses. It expresses in simple language some tender and delicate thought, generally of an amatory or pastoral character, though occasionally it ventures upon a higher strain. The etymology of the word is uncertain, and numerous opinions have been hazarded regarding it. The earliest madrigals were those of Lemmo of Pistoia, set to music by Casella, who is mentioned by Dante. They were generally cultivated in Europe from the latter part of the 15th to the end of the 18th century. In England they attained a high [illegible] during the reign of Elizabeth, and are said to be in no way inferior to those of Italy; the best known among English madrigal writers being Orlando Gibbons. The madrigals of Tasso are among the finest specimens of Italian poetry.

MAGAZINE, *măg-a zeen'* (Fr. *magazin*), in Lit., is the name given to certain periodical works of a miscellaneous character, containing a variety of essays in prose and verse, reviews, &c. The use of the word in this sense is of modern introduction, being in England first adopted in "The Gentleman's Magazine," the first number of which was published in January, 1731, and which has been regularly continued monthly to the present time. Soon after "The Gentleman's Magazine," a rival work appeared under the title of "The London Magazine;" but it was discontinued in 1785. "The Scots Magazine," which was commenced at Edinburgh in 1739, is also numbered with the things that were. Before the establishment of "The Gentleman's Magazine," the periodical publications were almost wholly confined to political transactions and to foreign and domestic occurrences. The magazines, however, have opened up extensive and various fields of inquiry, and have been the means of diffusing a general habit of reading throughout the country. In the present day articles by our most distinguished literary men and men of science are to be found in our magazines, so important a branch of literature have they now become.

MAGDALEN ASYLUMS, *măg'-dă-len*, is the name given to certain institutions which have recently been established in some of our larger towns, to afford a retreat to penitent prostitutes, and to enable them to forsake their evil mode of life. A society for this object was established in London in 1758, principally by the exertions of Dr. Dodd. These institutions have been the means of effecting much good, and of restoring to their families and to society many who would have otherwise been lost. By far the greater number of those who have been protected in such asylums have subsequently continued respectable and correct in their behaviour. In the asylum they are employed in various kinds of work, and no one who has conducted herself with propriety in the house is allowed to leave it unprovided for.

MAGDALEN COLLEGE, OXFORD, *maud'-a-len*, was founded in 1458, by William of Waynflete, bishop of Winchester, and lord high chancellor of England, for a president, 40 fellows, 30 scholars called *demies*, a schoolmaster, an usher, 4 chaplains, an organist, 8 clerks, and 16 choristers. The statutable restriction of fellowships to certain counties and dioceses is abolished by an ordinance framed for the college under powers granted by 17 & 18 Vict. c. 81; and ten of the fellowships are to be suspended, and ten demyships added to the statutable number. Demyships hereafter to be filled up are to be tenable, without reference to place of birth, for five years, and no longer. Twenty exhibitions are to be established for deserving persons in need of support, at the university; and four professorships (to be called the Waynflete professorships) are to be founded and maintained within the college, in lieu of the lectureships mentioned in the existing statutes. Among the eminent persons who received their education at this college are Cardinal Wolsey, Lilly the grammarian, Fox the martyrologist, Hampden, Hammond, Addison, and Gibbon. The number of members of convocation is 168, of members on the books 256.—Ref. *Oxford University Calendar for* 1872.

MAGDALEN HALL, OXFORD, was erected by Bishop Waynflete, for students previous to admission into his college, and was governed by one of the fellows till 1602, when it became an independent hall. This hall is possessed of one benefice, four scholarships for persons educated at Worcester-cathedral school, four open scholarships, two exhibitions for persons educated at the Hampton Lucy school, and two exhibitions in the appointment of the principal. All the scholarships and exhibitions are tenable for three years. If, in the judgment of the principal, candidates from the above-mentioned schools shall not be of sufficient merit, the scholarships and exhibitions are to be thrown open to general competition. Number of members of convocation 153, of members on the books 273.—Ref. [illegible] *for* 1872.

[illegible], CAMBRIDGE, was built by Edward Stafford, duke of Buckingham, in 1519, under the name of Buckingham House, on the site of an ancient hostel, belonging to the abbeys of Ely, Ramsey, and Walden. On the attainder of the duke, it fell to the crown, and was granted to Thomas lord Audley of Walden, lord high chancellor of England, who in [illegible] endowed it for a master and four fellows. It had [illegible] fourteen bye fellowships; but by the new statutes it is declared that,—(1) "No person shall hereafter be elected to any bye fellowship now existing in the college, (2) there shall hereafter be eight open fellowships on the foundation of the college, the conditions of tenure being specified in the new statutes; (3) the additional fellows and their successors shall be denominated respectively the Spendlufle, Wray, Drury, and Millington fellows, in commemoration of the benefactions made to the college by Mr. Spendluffe, Sir Christopher Wray, the Rev. Drue Drury, and Dr. M[illegible]." It is also declared that (except those scholarships and exhibitions, the right of preference to which is by act 19 & 20 Vict. c. 58, preserved to particular schools) all restrictions shall be entirely removed, and the total amount of such scholarships and exhibitions shall form a general fund for open scholarships. There shall hereafter be three open scholarships of at least £60, three of at least £40, and six of at least £20 a year each.—Ref. *Cambridge University Calendar.*

MAGDEBURG CENTURIES. (*See* CENTURIES OF MAGDEBURG.)

MAGGOT, *măg'-got* (W. *magrod*), in general language, a term used to designate the larvæ of dipterous, hymenopterous, and some coleopterous insects. (*See* INSECT-TRANSFORMATIONS.)

MAGI, *mai'-ji*, was the name given to the caste of priests among the ancient Medes and Persians.

The etymology of the word is doubtful, but it has been conjectured to be connected with the root of the Greek *megas* and Latin *magnus*, signifying great. The magi formed one of the six tribes into which the Medes were originally divided, and on the downfall of the Median empire, they continued to retain a great degree of power and authority with the conquerors, being the recognized ministers of the national religion. The great apostle of their religion was Zoroaster. They were so celebrated for their enchantments, that they have given name to the art of magic or enchantment. They were also learned as astrologers, and their name was applied to any one celebrated for wisdom; hence the wise men of the East who came to see Jesus are simply called magi. (*See* GUEBERS.)

MAGIC, *măj'-ĭk* (Lat. *magia*).—In its ancient sense, this word signified the science and doctrine of the magi, or wise men of Persia; in a more modern sense, magic is a science which teaches how to perform wonderful and surprising feats, or to produce unexpected effects. Originally, the word magic carried with it an innocent and praiseworthy meaning, being used to signify the study of wisdom and the more sublime parts of knowledge. When, however, the ancient magi engaged themselves in astrology, divination, sorcery, and other similar branches of the occult sciences, the term magic became in time of bad repute, and was only used to signify an unlawful and diabolical art, depending on the assistance of the devil and of the spirits of the dead. The possession of magical powers has formed a portion of superstitious belief among all nations at all times; but of all people, the ancient Romans were the most superstitious in this and other respects. They placed the utmost belief in auguries and divinations. It is also a remarkable fact, that while their religion decreed these rites, they were always searching after fresh excitement from others, which were not only unauthorized but condemned by their own laws. Amongst these may be mentioned the magical practices of the Thessalian witches, of the Persian magi, and of the sorcerers of Egypt and Phrygia, and the numberless other foreign nations with whom they were brought in contact by their conquests. The emperors were constantly issuing and renewing edicts against these practices in the most ineffectual manner, and it is probable that from this circumstance magic began to be looked upon as a black and unholy art,—an idea which became rooted in the minds of the inhabitants of southern Europe. In the North, supernatural power was looked upon with high respect; and in the East, the favourite land of sorcery and magic, the professors have been looked upon as venerable rather than as hateful from time immemorial. According to Cornelius Agrippa, magic may be divided into three kinds,—natural, celestial, and ceremonial or superstitious. *Natural magic* is simply the application of natural active causes to passive subjects, by means of which many surprising, but yet natural, effects are produced. Without doubt, such have been some of those miracles wrought by ancient magicians, whose knowledge of the various powers of nature, there is reason to believe, was much greater than the self-sufficiency of modern vanity is willing to admit. Amongst the Crusaders and other Christian warriors of the middle ages, magic was looked upon as a peculiar ally of the infidels, with whom they were in contact. In their imagination, also, the inhospitable North was peopled with enchanted castles and spectral illusions. In the romances of the period, founded on historical encounters, there is usually a good magician, who sides with the Christian party; while necromancers, who work evil, back up the infidels. *Celestial magic* closely resembles judicial astrology. It attributes to spirits a kind of rule or dominion over the planets, and to the planets a rule over the destinies of men. On this foundation, a ridiculous kind of system was built up. *Superstitious magic* consists in the invocation of devils. Its effects are usually evil, but surpassing the powers of nature, being supported by some supposed compact, either tacit or express, with evil spirits. There is every reason to believe that this species of magic originated in Egypt. The first magicians mentioned in history were Egyptians; and that people, so famed for their wisdom, not only believed in the existence of demons, but also that different orders of these spirits presided over the elements of fire, air, earth, and water, as well as over the persons and affairs of men. Consequently, every disease which flesh is heir to was laid to the charge of some particular demon. When a person was seized with a fever, or other complaint, they never thought of searching for the natural cause of the disease, and so curing it; but, attributing the complaint to the possession of some demon, they endeavoured to drive it forth by means of incantations and charms. These notions spread from the Egyptians to the Hebrews, amongst whom we find a belief that nearly every disease was due to the agency of demons or devils. Superstitions of a similar stamp were also brought from Egypt and Chaldea by Pythagoras, and transmitted by him and his followers to the Platonists of Greece. The advance of the Christian religion, the revival of learning, and the progress of natural science, long ago banished this kind of superstition from all the enlightened European nations.—*Ref.* Scott's *Demonology and Witchcraft*; Brewster's *Letters on Natural Magic*; *Quarterly Review*, vols. 48, 59; Windischmann's *Inquiries respecting Astrology, Alchemy, and Magic* (in German, Frankfort, 1818).

MAGICIANS, *mă-jish'-ăns*, is applied to such as practise the art of magic. The early Christians were derided by this name because it was pretended that our Saviour wrought his miracles by magic. Even in the time of Augustine, that writer speaks of a popular belief among the enemies of the Church, that Christ had written books on magic, which he delivered to Peter and Paul for the use of his disciples.

MAGIC LANTERN, a species of optical instrument, the object of which is to obtain an enlarged representation of figures on a screen in a darkened room, by means of light issuing from a lamp or candle and passing through a convex lens. The instrument consists of a lantern, generally of tin, and of a cubical form, in the interior of which is the light. At a perforation in one of the sides is applied a tube, projecting horizontally from it. Within the tube, and immediately before the aperture, is a lens, often nearly a hemisphere in form, and three or four inches in diameter; the tube also carries within it another, which is furnished with a convex lens, and is capable of a small movement for the purpose of adjustment. Between the lenses in the tube and the front of the lantern is a groove, which receives a rectangular frame containing a glass plate, on which are painted, in transparent colours, the objects of which an enlarged view is required. It is [illegible] used as a toy, and affords amusement from the grotesque character of the figures; it is also used to enlarge the diagrams in astronomical and other lectures, so as to be clearly seen by the audience. The magic lantern is said to have been invented by Kircher in the 17th century. It is described by him in his "Ars Magna Lucis et Umbræ." The invention, however, is also attributed to Cellini, who died in 1570.

MAGISTER, *mă-jis'-ter* (Lat., master), was formerly a title conferred upon one who had attained to some degree of eminence in literature or science. Those who are now styled doctors were formerly termed magistri.

MAGISTRATE, *măj'-is-trait* (Lat. *magistratus*), is a public civil officer vested with the executive government, or some branch of it. Of magistrates some are supreme, in whom the sovereign power of the state resides; others are subordinate, deriving their authority from the supreme magistrate, accountable to him for their conduct, and acting in an inferior or secondary sphere. In this country the supreme legislative power is vested in the parliament, and the supreme executive power in the crown. The subordinate magistrates are principally sheriffs, coroners, justices of the peace, constables, surveyors of highways, and guardians and overseers of the poor. Under their particular names in other parts of this work will be found an account of the different kinds of magistrates.

MAGNA CHARTA, *măg'-nă kar'-tă* (Lat., the great charter), in the constitutional history of England, is the "Great Charter of Liberties" extorted from King John in 1215. This charter is usually regarded as the constitutional basis of English liberties; but in many of its provisions it seems only to have been a declaration of the rights which had been enjoyed in England before the Conquest. The Anglo-Saxon institutions and

usages, which were very favourable to liberty, had been almost entirely suppressed by the Norman conquerors. Henry I., when he first seized the crown, to the exclusion of his elder brother Robert, being desirous to win the favour of the Saxon as well as the Norman inhabitants of the country, granted a charter, restoring many of the ancient liberties, and removing many of the feudal oppressions to which the military tenants of the crown were liable at the hands of the king. To the weakness or imbecility of King John we owe the possession of the Magna Charta, which, if it did not found the liberties of the English nation, at least defined and settled them. The barons, by the illegal and violent measures of the king, were driven to take measures for their own defence. At length a conference was held at Runnymede, on the Thames, between Staines and Windsor, on the 15th of June, 1215, and after a long discussion the Magna Charta was signed. To secure the execution of the charter, John was compelled to surrender the city and Tower of London, to be held by the barons till August 15, or until he had completely executed the charter. Further, the barons chose twenty-five of their number to be guardians of the liberties of the realm, with power to make war upon the king if he should violate the charter. The Magna Charta redressed many grievances incident to feudal tenures; prohibited unlawful amercements, distresses, or punishments, and restrained the royal prerogative of purveyance and pre-emption; it regulated the forfeiture of lands; established the testamentary power of the subject over part of his personal estate; laid down the law of dower; enjoined a uniformity of weights and measures; gave new encouragement to commerce; forbade the alienation of lands in mortmain; guarded against delays and denials of justice; fixed the court of Common Pleas at Westminster, and brought the trial of issues within the reach of all freemen by means of assizes and circuits; confirmed and established the liberties of the city of London, and other cities, boroughs, towns, and ports of the kingdom; and protected every individual of the nation in the enjoyment of his life, liberty and property, unless declared to be forfeited by the [illegible] his peers or the law of the land. More particularly it declares that "the Church of England shall be free and have her whole rights and her liberties inviolable," that "neither we nor our bailiffs shall seize any land or rent for any debt so long as the chattels of the debtor are sufficient to pay the debt; nor shall the sureties of the debtor be distrained so long as the principal debtor is sufficient for the payment of the debt," that "no scutage or aid shall be imposed in our kingdom unless by the general council of our kingdom, except for ransoming our person, making our eldest son a knight, and once for marrying our eldest daughter, and for these there shall be paid a reasonable aid," "a freeman shall not be amerced for a small fault, but after the manner of the fault, and for a great crime according to the heinousness of it, saving to him his contenement (*i. e.*, the means of his livelihood; as the tools of a mechanic, or the like), and after the same manner a merchant, saving to him his merchandise, and a villein shall be amerced after the same manner, saving to him his wainage (his plough, waggons, &c.), and none of these aforesaid amercements shall be assessed but by the oath of honest men in the neighbourhood;" "no freeman shall be taken, or imprisoned, or disseised, or outlawed, or banished, or anyways destroyed; nor will we pass upon him, nor will we send upon him, unless by the lawful judgment of his peers or by the law of the land; we will sell to no man, we will not deny to any man, either justice or right;" "all merchants shall have safe and secure conduct to go out of and to come into England, and to stay there and to pass, as well by land as by water, for buying and selling, by the ancient and allowed customs, without any evil tolls, except in time of war, or when they are of any nation at war with us;" "it shall be lawful for the time to come for any one to go out of our kingdom and to return safely and securely by land or by water, saving his allegiance to us;" "we will not make any justices, constables, sheriffs, or bailiffs, but of such as know the law of the realm and mean duly to observe it;" "if any one has been dispossessed or deprived by us without the legal judgment of his peers, of his lands, castles, liberties, or right, we will forthwith restore them to him, and if any dispute arise upon this head, let the matter be decided by the five-and-twenty barons hereafter mentioned for the preservation of the peace." These concessions being unwillingly granted by the king, would gladly have been withdrawn; but the barons were watchful of their interests, and his son Henry III. was obliged to make one or more solemn ratifications of the charter. "It was," says Sir James Mackintosh, speaking of the Magna Charta, "a peculiar advantage that the consequences of its principles were, if we may so speak, only discovered gradually and slowly. It gave out on each occasion only so much of the spirit of liberty and reformation as the circumstances of succeeding generations required, and as their character would safely bear. For almost five centuries it was appealed to as the decisive authority on behalf of the people, though commonly so far only as the necessities of each case demanded." "To have produced it, to have preserved it, to have matured it, constitute the immortal claim of England upon the esteem of mankind."—Ref. *The Great Charter and Charter of the Forest*, by Sir W. Blackstone; *The English Constitution*, by Sir E. S. Creasy.

MAGNANIMITY, *măg-nă-nim'-e-te* (Lat. *magnus*, great, and *animus*, mind), is literally great-mindedness, the possession of a mind above being swayed to and fro by the good or evil of this life. Magnanimity was a virtue much extolled by the ancient philosophers.

MAGNESIA, *măg-nē'-she-a* (from Magnesia, a city of Lydia, near which it was originally found), one of a group of alkaline earths, of which baryta, strontia, and lime, form the other members. It is the oxide of the metal magnesium (which *see*), and is generally prepared by calcining the carbonate at a high heat, until it glows with a peculiar luminous appearance, called brightening. It is much used in pharmacy, under the name of *calcined magnesia*. For the laboratory, it may be procured in a state of purity by igniting the pure nitrate. It is a white powder, varying in density according to the source from which it is obtained. It is unalterable by heat, and has never been fused. It slowly absorbs carbonic acid and water from the air; moistened with water, it combines with it, raising the temperature during the union, and giving rise to *hydrate of magnesia*. Crystallized hydrate of [illegible] in nature as the mineral brucite. It [illegible] powder, which slowly absorbs carbonic acid from the air. Its water is easily expelled by heat. It [illegible] soluble in water, forming a solution [illegible] alkaline reaction. It is used in pharmacy as an antacid and cathartic.

MAGNESIA, CARBONATES OF.—There are three carbonates of magnesia,—the bicarbonate, monocarbonate, and subcarbonate. The monocarbonate is found in nature in a hydrated condition, as the mineral magnesite. The anhydrous salt may be prepared by placing a tube containing a solution of carbonate of soda in a strong glass tube containing a solution of sulphate of magnesia, sealing the outer tube hermetically, heating it to 320° Fahr., and inverting the whole, so that the solutions may mix; crystalline grains of anhydrous carbonate being deposited. It is insoluble in water, but dissolves in acids. Heated, it becomes converted into magnesia. It dissolves in water saturated with carbonic acid, forming bicarbonate of magnesia. The subcarbonate is prepared by boiling a solution of the sulphate with excess of carbonate of potash or soda, and filtering and washing until the washings give no precipitate with chloride of barium. Prepared thus, it forms a bulky white powder, and is known as *light carbonate of magnesia*. The *heavy carbonate* has the same composition, and is prepared by mixing hot solutions of carbonate of soda and sulphate of magnesia. It is much less bulky than when prepared in the preceding manner. Both forms are extensively used in medicine as a cathartic and antacid. Carbonate of magnesia is capable of combining with other carbonates to form double salts. The double carbonates of magnesia, potash, soda, ammonia, and lime, are instances of this.

MAGNESIA, CITRATE OF.—This salt is much used in pharmacy as a gentle aperient. It is prepared by mixing powdered carbonate of magnesia and citric acid into a paste with a small quantity of water, and granu-

lating. A teaspoonful in water forms a pleasant effervescing cathartic of a gentle character.

MAGNESIA, NITRATE OF.—Nitrate of magnesia occurs in the mother-liquors of the sulphate refiners. It may be prepared by evaporating a solution of the carbonate in dilute nitric acid to crystallization. The salt forms deliquescent prisms of the formula $MgNO_6+6Aq$. Exposed to a temperature of 482° Fahr., it is converted into a basic nitrate, and all the nitric acid is expelled by a red heat.

MAGNESIA, PHOSPHATE OF.—The bibasic salt may be obtained by mixing hot concentrated solutions of the sulphate with phosphate of soda. It crystallizes in hexagonal needles, containing fourteen equivalents of water, which are entirely expelled at a high temperature, giving rise to pyrophosphate of magnesia. Phosphate of magnesia is only interesting from entering into the composition of bones of animals. It is also found in combination with ammonia, as a constituent of urinary calculi.

MAGNESIA, SILICATES OF.—Numerous examples of these occur in the mineral kingdom. Meerschaum, steatite, chrysolite, olivine, and peridote, are all silicates of magnesia. Augite, amphibole, asbestos, and hornblende, are double silicates of lime and magnesia, more or less coloured by oxide of iron. Serpentine is a mixture of the silicate and hydrate, coloured with metallic oxides, and talc is a hydrated silicate.

MAGNESIA, SULPHATE OF.—This salt occurs in nature as *hair salt*, as an efflorescence on certain magnesian metals. It exists in sea-water and certain spring waters in considerable quantity. The springs of Epsom, Cheltenham, Seidlitz, and Pullna, are famous for the amount of this salt they contain. The sulphate of magnesia of commerce, so extensively used in medicine as a cathartic, is prepared in several ways; the most common of which is to dissolve dolomite, or magnesian limestone (carbonate of lime and magnesia), in dilute sulphuric acid, by which means sulphate of lime is precipitated, and the sulphate of magnesia may be obtained by evaporating to crystallization. Its other sources are the mother-liquor of sea-salt, and refuse alum-liquors. This salt crystallizes in rectangular four-sided prisms, containing six equivalents of water, which [illegible] dry air. It is very soluble in water, 100 parts of water dissolving 69 parts of the salt at ordinary temperatures, and 150 parts at boiling-point. It is sparingly soluble in alcohol. It is employed in the laboratory as a re-agent; in which case it should be made by dissolving the pure carbonate in sulphuric acid, as the commercial salt is largely adulterated with sulphate of soda. Its water of constitution is capable of being replaced by alkaline sulphates, giving rise to double salts.

MAGNESITE, in Min., native carbonate of magnesia, occurring in serpentine in compact hard amorphous masses.

MAGNESIUM, *mag-ne-she'-um*, in Chem., symbol Mg, equiv. 12, spec. grav. 1.743,—the metallic base of the alkaline earth magnesia, first isolated by Bussy, who obtained it [illegible] the chloride with potassium at a high [illegible]. It is a white malleable silvery metal, constant in dry air, but becoming covered with a white film of magnesia in the presence of moisture. It decomposes water at the boiling-point, eliminating hydrogen. Heated to dull redness in air or oxygen, it burns with a bright light, and is converted into magnesia. It fuses at a red heat, and may be distilled out of contact with the air. It forms only one oxide,—magnesia. The best method of preparing magnesium is that lately patented by Mr. E. Sonstadt, which consists in evaporating a mixed solution of the chlorides of [illegible] sodium to a dry mass, which, when heated with sodium in an iron vessel, yields the metal in a state of comparative purity. This process promises to yield magnesium in quantities, at a price that would secure its common use. In many of its characters, metallic magnesium resembles zinc. It is the lightest known metal that remains constant in the air at ordinary temperatures.

MAGNESIUM, CHLORIDE OF, in Chem.—This salt is found in large quantities, in company with the iodide and bromide, in the mother-liquors of salt-works; but the pure salt is best prepared by dissolving the carbonate in hydrochloric acid, evaporating and crystallizing. The anhydrous chloride is made by saturating hydrochloric acid with carbonate of magnesia and adding excess of chloride of ammonium, evaporating to dryness, and heating in a platinum-dish. The double chloride is decomposed, the whole of the chloride of ammonium being expelled, and the anhydrous chloride of magnesium remaining behind. The anhydrous chloride forms white deliquescent masses. The crystallized salt forms colourless deliquescent needles, containing six equivalents of water. It forms double salts with the chlorides of the alkaline metals.

MAGNESIUM, SULPHIDE OF, in Chem.—This compound is obtained with difficulty by precipitating sulphate of magnesia with sulphide of barium. Its properties have not been much investigated.

MAGNET, NATURAL, *mag'-net* (from *Magnesia*, a province in Lydia, whence the Greeks obtained the loadstone), a body endowed with magnetic polarity. The *natural magnet*, or *loadstone*, is a species of iron-ore found in various parts of the earth in irregular or crystalline fragments, and occasionally in beds of considerable thickness. Its property of attracting small pieces of iron was recognized at a very early date by the Greeks, and its wondrous directive power has been known to the inhabitants of China from time immemorial. If a piece of this magnetic iron-ore be carefully examined, it will be found that the attractive force for ferruginous particles is greatest at certain points of its surface, while elsewhere it is much diminished, or even altogether absent. These attractive points are called the *poles* of the magnet. If one of the pole surfaces of a natural loadstone be rubbed in a particular manner over a bar of hardened steel, its characteristic properties will be communicated to the bar, which will then be found to attract iron-filings like the loadstone itself. Further, the attractive force will appear to be greatest at two points situated very near the extremities of the bar, and least of all towards the middle. The bar of steel so treated is said to be *magnetized*, or to constitute an *artificial magnet*. For general purposes artificial magnets are made from straight bars, or from bars bent into a curvilinear form, resembling a horseshoe. The latter are particularly well adapted for displaying the attractive force, as the two poles can be brought into contact with the object to be lifted. Straight bars must, of course, be used in experiments upon the directive power. Many artificial magnets, either straight or curved, may be combined together so as to form a *compound magnet*. The poles of a compound horseshoe magnet are generally armed with pieces of very soft iron, to which a movable piece of soft iron, called a *keeper* or *lifter*, may be conveniently applied. This keeper is found to preserve and increase the force of the poles in a very remarkable manner. A natural magnet may be armed in a similar manner. An *electro-magnet* is a bar of soft iron in which magnetism is temporarily induced by a circulating current of electricity.—For full directions for forming all kinds of artificial magnets, the reader is referred to Sir W. S. Harris's *Rudimentary Magnetism*. (*See* MAGNETISM, ELECTRO-MAGNETISM, and MAGNETO-ELECTRICITY.)

MAGNETIC IRON PYRITES, a variety of iron pyrites having magnetic properties, found in hexagonal prisms of a bronze colour. The composition of magnetic pyrites may be represented by the formula F_7S_8.

MAGNETIC NEEDLE. (*See* COMPASS and DIPPING-NEEDLE.)

MAGNETISM, *mag'-net-izm*, literally, the attractive and repulsive power of the loadstone; generally, that peculiar property possessed by many mineral bodies, and by the whole mass of the earth, through which, under certain circumstances, they mutually attract and repel one another, according to determinate laws. When a magnetized bar, or natural magnet, is suspended at its centre in any convenient manner, so as to be free to move in an horizontal plane, it is always found to assume a particular direction with regard to the earth, one end pointing nearly north and the other nearly south. If the magnet be moved from this position, it will tend to reassume it, and, after a few oscillations, settle at rest as before. The extremity which points towards the astronomical north is usually distinguished as the *north pole* of the magnet, and that which points southward as the *south pole*. Every

magnet, whether natural or artificial, has the two poles; and as these are the points of greatest attraction, their positions can be readily ascertained by plunging the magnet into fine iron filings. A suspended bar magnet serves to exhibit certain phenomena of attraction and repulsion in the presence of a second magnet, which deserve particular attention. When a north pole is presented to a south pole, or a south pole to a north, attraction ensues between them; the ends of the bars approach each other, and, if permitted, adhere with considerable force. When, on the other hand, a north pole is brought near a second north pole, or a south pole near another south pole, mutual repulsion is observed, and the ends of the bars recede from each other as far as possible. Poles of an opposite name attract, and of a similar name repel, each other. A small bar or needle of steel, properly magnetized and suspended, and having its poles marked, thus becomes an instrument fitted not only to discover the existence of magnetic power in other bodies, but to estimate the kind of polarity affected by their different parts. A piece of soft iron brought into the neighbourhood of a magnet acquires itself magnetic properties; the intensity of the power thus conferred depends upon that of the magnet, and upon the interval which divides the two, becoming greater as that interval decreases, and greatest of all when in actual contact. The iron, under these circumstances, is said to be magnetized by *induction*, and the effect, which in an instant reaches its maximum, is at once destroyed by removing the magnet. When steel is substituted for iron, the inductive action is hardly perceptible at first, and only becomes manifest after the lapse of a certain time. The steel bar, on being removed from the magnet, does not entirely lose the induced polarity. It becomes, indeed, a permanent magnet, similar to the first, and retains its peculiar properties for an indefinite period. Magnetic attractions and repulsions are not in the slightest degree interfered with by the interposition of substances destitute of magnetic properties. Thick plates of glass, shell-lac, metals, wood, &c., may be placed between a magnet and a suspended needle, or a piece of iron under its influence, the distance being preserved, without the least perceptible alteration in its attractive power or force of induction. One kind of polarity cannot be exhibited without the other. If a magnetized bar of steel be broken at its neutral point, or in the middle, each of the broken ends acquires an opposite pole, so that both portions of the bar become perfect magnets; and if the division be carried still further, if the bar be broken into a hundred pieces, each fragment will be a complete magnet, having its own north and south poles. The direction spontaneously assumed by a suspended needle indicates that the earth itself has the properties of an enormous magnet, whose south magnetic force is concentrated in the northern hemisphere. A line [illegible] the two poles of such a needle or bar in[illegible] direction of the so-called *magnetic meridian* [illegible] place. This is not usually coincident with the geographical meridian of the place, but makes with it a certain angle, called the *declination* of the needle. The amount of the declination of the needle from the true north and south not only varies at different places, but in the same place is subject to daily, yearly, and secular fluctuations, which are called the *variations of declination*. At the commencement of the 17th century the declination was eastward of our meridian; in 1660 it was 0, that is, the needle pointed due north and south. Afterwards it became westerly, slowly increasing until the year 1818, when it reached 24° 30′; since which time it has been slowly diminishing. If an unmagnetized steel bar be supported on a horizontal axis passing exactly through its centre of gravity, it will of course remain equally balanced in any position in which it may happen to be placed; if the bar so adjusted be then magnetized, it will be found (in the latitude of London) to take a permanent direction, the north pole being downwards, and the bar making an angle of about [illegible], with a horizontal plane passing through the axis [illegible] is called the *dip or inclination* of the needle, and shows the direction in which the force of terrestrial magnetism is most energetically exerted. The amount of dip is different in different latitudes: near the equator it is very small, the needle remaining nearly, or quite, horizontal; as the latitude increases, the dip becomes more decided, and over the magnetic pole the bar becomes completely vertical. Like the horizontal declination, the dip is subject to change at the same place. In the year 1773 it was about 72°; at the present time it is near 68° 32′ in London. The mariner's compass, which is nothing more than a suspended magnetic needle attached to a circular card marked with points, [illegible] use in Europe before the year 1300, although the Chinese have had it from very remote antiquity. Its value to the navigator is now very much increased by correct observations of the exact amount of the declination in various parts of the world. Probably every substance in the world contributes something to the magnetic action of the earth; for, according to the discoveries of Faraday, magnetism is not peculiar to those substances which have more especially been called magnetic, such as iron, nickel, and cobalt, but is rather to be considered as a universal agency. Faraday divides all bodies into two classes, calling the first *magnetic*, or better, *paramagnetic*, and the other *diamagnetic*. The matter of which a paramagnetic body consists is attracted by both poles of a powerful horseshoe magnet; on the contrary, the matter of a diamagnetic body is repelled. When a small iron bar is hung by untwisted silk between the poles of the magnet, so that its long diameter can easily move in a horizontal plane, it arranges itself axially, that is, parallel to the straight line which joins the poles. A diamagnetic bar formed of bismuth, for instance, arranges itself equatorially, that is, at right angles to the magnetic axis.—For a concise exposition of the chief phenomena of magnetism we may refer the reader to Fownes's *Manual of Chemistry*, and for fuller details to Sir W. S. Harris's *Rudimentary Magnetism*, and Faraday's *Experimental Researches*.

MAGNETISM, TERRESTRIAL. (*See* MAGNETISM.)

MAGNETO-ELECTRICITY, an important branch of electrical science which has sprung from Faraday's discovery of the development of electrical currents by the action of magnetism. If two extremities of the coil of an electro-magnet be connected with a *galvanometer* (*see* this word) and the iron temporarily magnetized by the application of a permanent steel horseshoe magnet to the ends of the bar, a momentary current will be developed in the wire and pointed out by the movement of the galvanometer needle. It lasts but an instant, the needle returning, after a few oscillations, to a state of rest. On removing the magnet, whereby the polarity of the iron is at once destroyed, a second current or wave will become apparent, but in the opposite direction to that of the first. By employing a very powerful steel magnet, surrounding its iron keeper or armature with a very long coil of wire, and then making the armature itself rotate in fr[illegible] the faces of the magnet, so that its induced [illegible]l be rapidly reversed, magneto-electric [illegible] be produced of such [illegible]ity as to give bright sparks and powerful shocks, and exhibit all the phenomena of voltaic electricity. Many powerful arrangements of this kind have been devised for the medical application of current electricity. (*See* ELECTRO-MAGNETISM.)

MAGNOLIACEÆ, *mag-no'-le-ai'-se-e*, in Bot., the Magnolia fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, having the following essential characters:—Trees or shrubs with alternate leaves; stipules usually present, and then large, sheathing the leaf-bud, and deciduous. Sepals and petals with a ternary arrangement of their parts, hypogynous, the former deciduous, the latter with an imbricated æstivation. Carpels distinct. Albumen homogeneous. The plants of this order are remarkable for the fragrance and beauty of their flowers and foliage; hence they are favourite objects of culture in this country, either as hardy plants, as several magnolias and the tulip-tree (*Liriodendron tulipifera*), or as stove and greenhouse [illegible]. Medicinally, the plants are chiefly remarkable [illegible]: bitter, tonic, aromatic properties. The bark of *Magnolia glauca*, the swamp-sassafras, or beaver-tree, resembles cinchona in its action. The unripe fruits of other species of the typical genus, as *M. Fraseri* and *acuminata*, have similar tonic and aromatic properties. The majority of the order are found in

North America. Some also occur in the West Indies, Japan, China, India, South America, Australia, and New Zealand. There are 12 genera and 168 species.

MAGPIE, *mag'-pie* (*Pica caudata*), a bird belonging to the fam. *Corvidæ*, whose generic characters are as follows:—Beak strong, compressed laterally, slightly arched and hooked at the tip; nostrils basal, covered with short stiff feathers, and directed forwards; wings short and round, the first quill-feather being very short, and the fourth or fifth the longest in the wing; tarsus longer than the middle toe; tail long and graduated. The magpie can be well distinguished as one of our handsomest native birds; but with a handsome exterior, yet, on account of its thieving habits, it has a most suspicious character. With regard to its appearance, the beak is black, the irides hazel, the head, neck, and upper tail-coverts jet-black; the scapulars pure white; the wing-coverts and tertials of a fine shining blue; the primaries black, with an elongate patch of pure white on the inner web of each of the first ten feathers; the tail graduated, the outside feather on each side not exceeding five inches in length, while the inner one extends eleven inches, and is of a beautiful iridescent colour; blue and purple near the end, and green from thence to the base. The chin and throat of the bird are black, the shaft of some of the feathers shining greyish white; the upper part of the breast black, while the lower part of the same, the belly, sides, and flanks, are of a pure white colour, finally, the thighs, legs, toes, and claws, are uniformly black. —(*Yarrell.*) The male magpie is generally eighteen inches in length, while the female is slightly smaller. It feeds on both animal and vegetable substances, destroys great numbers of grubs and slugs in pasture land, and performs a very friendly office to sheep and oxen, by getting on their backs and freeing their wool and hides from troublesome vermin. It is a social, and yet not a gregarious bird, and has always been an object of superstition to the vulgar. Magpies, to refer once more to Mr. Yarrell's excellent work, generally continue in pairs all the year round. They build in high trees, sometimes in a lofty hedge, and occasionally in a low but thick bush, returning to the same nest for many years in succession. The nest is well constructed for security against enemies; it is of an oval shape, and large, framed on the outside with sharp thorny sticks, strongly interwoven, and forming a dome over the top, the inside being plastered with mud and lined with dry grass. One small aperture is left on the side, just large enough to admit the parent bird, who generally sits with her head to the hole, ready to quit the nest on the slightest alarm. The magpie breeds early in spring, producing six or seven eggs of a pale bluish-white colour, spotted all over with ash-colour and two shades of greenish brown: the length of each egg being about one inch and four lines and a half, while the breadth is about an inch. The magpi [illegible] the most destructive birds under the sun, as Mo[illegible] observes, it "is governed by self-interest, it is a great enemy to the husbandman and the preserver of game, but has cunning enough to evade their pursuit. No animal food comes amiss to its carnivorous appetite, young poultry, eggs, young lambs, and [illegible]en weakly sheep, it will attempt to destroy by first plucking out their eyes; the young of hares, rabbits, and feathered game, share the same fate; fish, carrion, insects, and fruit, and lastly grain, when nothing else can be got. It is an artful, noisy bird, proclaiming aloud any apparent danger, and thereby gives notice to its associates. Neither the fox, or other wil[illegible]nal, can app[illegible] out being observed and hunted; [illegible] the fowler is frequently spoiled of his sport; for all other birds s[illegible]em to know the alarming chatter of the magpie."—*Ref.* Yarrell's *British Birds*.

MAHABHARATA, or BHARATA, *ma-hab-a-ra'-ta*, is the name of the most celebrated epic poem of the Hindoos, after the Ramayana. This poem is chiefly devoted to an account of a long civil war between two dynasties of ancient India,—the Kurus and Pandus; but around this history an immense collection of ancient traditions, moral reflections, and popular stories, have been gathered. The earlier sections of the book are chiefly occupied in solving theogonical and cosmogonical problems, while in the last chapters are didactic and moral episodes on religious duties and sacrifices, forming an almost complete system of Hindoo ethics, and a compendium of the Brahminical faith. As compared with the Ramayana, the Mahabharata is wanting in unity and internal coherence; but, at the same time, it contains a greater variety of pleasing scenes and attractive situations. The poem is a work of great antiquity, but neither the time of its composition nor the period in which it assumed its present shape can be ascertained. The great war is, undoubtedly, an historical event, and is supposed to have taken place in the 12th century B.C.; and the entire poem is a valuable mine of antiquarian lore on the early history of the Hindoos. A complete edition of the Mahabharata, in the original Sanscrit, has been published by the Asiatic Society of Bengal; and a number of detached fragments and stories have been translated by Sir Charles Wilkins, Prof. Wilson, and Mr. Milman.—Ref. *English Cyclopædia*,—Arts and Sciences, where an able analysis of this poem [illegible] to be found.

MAHOGANY. (*See* SWIETENIA.)

MAHOMETANISM. (*See* MOHAMMEDANISM.)

MAIDEN, *maid'-en*, the name given in Scotland to an instrument formerly used in beheading criminals, resembling in its construction the guillotine of the French. (*See* GUILLOTINE.)

MAIDEN ASSIZES, is a term applied to those assizes at which no person is condemned to die.

MAIDENHAIR (*See* ADIANTUM.)

MAIM, or MAYHEM, *maim, mai'-hem* (Lat. *mayhemium*), in Law, is defined to be "the violently depriving another of such of his members as may render him the less able in fighting, either to defend himself or to annoy his adversary." Hence the cutting off or disabling, or weakening a foot, a hand, or a finger, the [illegible] out an eye or a foretooth, are mayhems; but the [illegible] off an ear or nose, or the like, are not held to be mayhems, because they do not weaken a man, but only disfigure him. The distinction, however, has, by statutory alterations, become of little importance. By the ancient law of England, mayhem was punished by inflicting upon the offender the same injury which he had caused to the person maimed. Afterwards the offence was only punishable by fine and imprisonment. The previous acts bearing upon this subject were repealed by stat. 1 Vict. c. 85, which enacts that the stabbing, cutting, or wounding, or causing bodily injury to any person, dangerous to life, with intent to commit murder, is felony, and punishable with death; the attempting, by any means, to maim, disfigure, or disable any person, or to do him some bodily harm, [illegible] ntent to resist or prevent the apprehension or detainer of any one, is punishable by transportation for life or not less than fifteen years (now penal servitude), or by imprisonment not exceeding three years. By 9 & 10 Vict. c. 25, any mayhem occasioned by maliciously causing gunpowder or other substance to explode, [illegible] the [illegible]sing to be taken by any person any dangerous thing, or the casting at or applying to any person any corrosive fluid or dangerous substance, with intent to maim, is a felony, and punishable with transportation for life or imprisonment for three years. Besides these proceedings, taken in name of the crown on behalf of public justice, the party injured may recover compensation in the shape of damages in an action of trespass.

MAINOUR, or MANOUR, *main'-oor, man'-oor* (Fr. *manier*, to handle), in Law, denotes the thing taken or carried away by a thief; thus, to be taken with the mainour is to be taken with the thing stolen about him. Formerly, by the common law, a thief taken with the mainour might be brought into court, arraigned, and tried without indictment.

MAINPRISE, *main'-prize* (Fr. *main*, the hand, and *pris*, taken), in Law, is the taking or receiving of a person into friendly custody, who might otherwise be committed to prison, upon security given that he shall be forthcoming at a time and place assigned. Mainprise differs from bail in that he who is mainprised is said to be at large until the day of his appearance; but he that is bailed is not said to be at large, or at his own liberty, but may be confined by his sureties. The writ of mainprise is directed to the sheriff, commanding him to take sureties for the prisoner's appearance, usually called mainpernors, and to set him at large.

Maintenance, *main'-ten-ăns* (Lat. *manutenentia*), in Law, is the unlawful taking in hand, or upholding of any cause or person,—the officious intermeddling in a suit that in no way belongs to one, by maintaining or assisting either party with money or otherwise to prosecute or defend it. By the common law, persons guilty of maintenance may be prosecuted by indictment, and be fined and imprisoned, or be compelled to make satisfaction, by action, &c.; but prosecutions for maintenance are now rarely instituted. Where more than one person is implicated in this offence, the practice is to indict them for a conspiracy.

Maize. (*See* Zea.)

Majesty, *măj'-es-te* (Lat. *majestas*), is a title of the highest honour, derived from the Romans, by whom it was first used to designate the supreme power and dignity of the people collectively (*majestas populi* [illegible]). The majestas was also ascribed to the highest chosen representatives of the people; as dictators, consuls, and the senate. On the overthrow of the republic, this title and dignity was assumed by the Roman emperors, and after them it was adopted by the emperors of the West. The attribute of majesty was not given to kings till a much later period. The courtiers introduced the title in France under Henry II., and in England it was first adopted by Henry VIII. It is now generally borne by all emperors and kings of Europe, except the sultan of Turkey, who is styled highness. The official title of the emperor of Austria is imperial-royal majesty (*kaiserlich-koniglich majestat*) On the continent of Europe, majesty is used also to denote the royal dignity and privileges derived therefrom, even in the case of princes who have not personally the title; and it has sometimes also been retained in the case of abdicated monarchs. The pope conferred the title of apostolic majesty on Stephen, the first king of Hungary, and thus is still borne by the emperor of Austria, as his representative. At a later period, the papal see conferred the title of Catholic Majesty on the kings of Spain, of Most Christian Majesty on the kings of France, and of Most Faithful Majesty on the kings of Portugal. The term *majestatsbrief*, charter of majesty, is applied to the act by which the emperor Rudolf II. (11th June, 1609) granted free exercise of their religion to the Protestants of Bohemia; the abolition of which act by the emperor Matthias, in 1618, was one of the principal causes of the Thirty Years' war, and of the intellectual debasement which is still manifest in that fair country. Violations of the majesty of the people were termed by the Romans *crimina* [illegible] term also applied to violations of [illegible] or treason

Majolica, or **Faience**, *ma-yol'-e-ka*, a kind of fine pottery made to imitate porcelain, and superior to common pottery in its glazing, beauty of form, and richness of colouring. Its name of faience, is derived from the town of Faenza, in Romagna, where it is said to have been first manufactured in 1299. This fine pottery was called by the Italians Majolica, probably from the name of its inventor. Some of the great artists of the period, Raffaelle, Giulio Romano, Titian, and others, painted upon this material, and the preserved specimens are highly valued as works of early art. Between 1530 and 1560 the majolica reached its highest perfection. The king of Wurtemburg possesses a valuable collection of it. Modern faience seems to have been invented about the middle of the 16th century, and obtained its name in France, when a man from Faenza discovered a similar clay at Nevers, and introduced the manufacture of it. English stone ware, made of powdered flint, has some resemblance to majolica ware, but is, in reality, very different. The manufacture of majolica has greatly improved in this country of late years. The majolica fountain exhibited at the International Exhibition of 1862, by Messrs. Minton, was a very elegant work of art.

Major, *mai'-jor* (Lat.), in Mus., is the name applied to that of the two modern modes in which the third is four semitones above the tonic or key-note It is also employed to indicate those intervals which contain the greatest number of semitones under the same denomination; as a third consisting of four semitones instead of only three, is called a *major third*; or a sixth containing nine instead of eight semitones, is termed a *major sixth*.

Major, in Logic, is a term applied to the first proposition of a regular syllogism, because it has a more extensive sense than the minor proposition. Thus, No unholy man is qualified for happiness in heaven (*major*); every man in his natural state is unholy (*minor*): therefore, no man in his natural state is qualified for happiness in heaven (conclusion or inference).

Majorana, *maj-o-rai'-nă* (said to be a corruption of the Arab. *maryamych*), in Bot., a gen. of the nat. ord. *Labiatæ*. The species *M. hortensis* (*Origanum Majorana* of Linnæus) is the sweet marjoram of the gardens, so much used as a flavouring herb by the cook. It is retained in the materia medica as a stimulant and carminative, but is scarcely ever used medicinally. The common marjoram belongs to the genus *Origanum*.

Majorat, *ma'-jor-a*, is a term used on the continent of Europe to denote, in its widest sense, the order of succession, which is determined by age and the right of preference which hence belongs to the oldest. There are three kinds of majorats.—1. Primogeniture, or the right of the first-born, by which the eldest in the eldest line always succeeds to an inheritance. This law regulates the succession to the throne in almost all the European states in the present day. 2. Majorat, in the stricter sense, which, among relatives of the same rank, gives the inheritance to the eldest. 3. Seniority, which, without regard to the nearness of relationship, always selects the eldest in the family. All the three kinds of majorats differ from the ordinary modes of succession in that they do not admit of any division of property. The tendency of majorats is to retain the property of a state in a few hands, and where they prevail, have generally been regarded with disfavour by the great majority of the people. The more the wealth of a country is concentrated in a few hands, the more liable is the bulk of the population to experience the evils of want

Major Domus, *mai'-jor do'-mus* (Fr. *maire du palais*), was in the Frankish kingdom under the Merovingian monarchs the title of the highest officer of court and state. The major domus was, originally, the superintendent of the royal domains; and from the influence and power which they thus acquired, together with the weakness of the monarchs, they rose to the possession of almost supreme power, and play an important part in the history of the period. At length Pepin, who held this office, made himself king. Ref. *Geschichte der Merovingischen Hausmaier*, by G. H. Pertz, Hanover, 1819 In Italy, the term *major-duomo* is frequently used to signify a steward or master of the household.

Major-General. (*See* General.)

Majority, *ma-jor'-e-te* (Fr. *majorité*), is a term used to designate the greater [illegible] constituting any body or corporation, by the opinions of whom their acts are generally determined, as a majority of the House of Commons The term is also used to denote the state of being at full age

Mal, *măl* (Lat. *malus*, bad), is a prefix of certain words, meaning bad, wrong, fraudulent; as, mal-administration, mal-practice, &c.

Malachi, Book of, *măl'-ă-ki*, is the last of the canonical books of the Old Testament. The name denotes "my angel," or rather, "angel of Jehovah;" and hence some have been led to the opinion that the author of the book was an angel; others hold that the word is not a proper name, but only an appellative, and ascribe its authorship to Ezra, Nehemiah, and others. At all events, nothing is known definitely concerning the author. That Malachi flourished after the time of Zechariah is evident from the fact that he is not mentioned along with him in the book of Ezra; and, from the contents of the book itself, he is judged to have been contemporary with Nehemiah, and therefore to have lived from about B.C. 420. The book is a connected prophetic discourse respecting the relation of Jehovah to his people, and may be divided into three parts.—1. Setting forth the loving, fatherly, and merciful providence of God towards his covenant people, reproving them for not honouring him as a father, and denouncing the priests for not teaching the people their duty (i.—ii. 9); 2 censuring intermarriages of Jews with women of another country (ii. 10—16); 3. announcing the approach of the Messiah, "the messenger of the covenant," and of his forerunner, John the

Baptist, under the name of Elijah, to purify the priests and smite the land with a curse, unless there be repentance; declaring, also, the distinction that shall be finally made between the righteous and the wicked, and concluding with an impressive assurance of approaching salvation to those that feared God, and a solemn injunction to the people to observe the law of Moses while expecting the promised Messiah (ii. 17—iv. 6). The language of this book wants the fire and force of the earlier prophets, indicating clearly the decay of the prophetic spirit. The authenticity of it is established by various allusions to it in the New Testament.

Malachite, *măl'-ă-kīte*, a mineral found in Siberia, South Australia, and other parts of the world, in concretionary masses consisting of carbonate of copper. When cut and polished, it shows its structure in series of concentric circular markings of different shades of green, corresponding to the concretions. It is much admired as an ornamental stone for inlaying purposes, the fitting together of the circular markings affording much scope for artistic treatment. The amorphous and less regular masses form an important ore of copper. Malachite is found in small quantities in Cornwall and Wicklow. The term is derived from the Gr. *malache*, the mallow flower, or *malakos*, soft; hence called also *velvet* copper ore.

Malacology, *măl-a-kol'-o-je* (Gr. *malakos*, soft, and *logos*, a discourse), a name applied by some naturalists to the study of conchology, which will be found treated under Mollusca.

Malacopterygians, [illegible] (Gr. *malakos*, soft, *pteryx*, fin), a term applied in ichthyology to such fishes as have the rays of their fins bony, although not pointed or sharp at the extremities like those of the class termed acanthopterygious fishes.

Mala Fides, *mā'-la fi-deez* (Lat.), in Law, denotes bad faith, in opposition to *bona fides*, or good faith. Questions of bad faith must be referred to a jury.

Mala in se, *mā'-lă in se* (Lat.), in Law, is applied to wrongs of themselves; as murder, robbery, perjury, &c. *Mala prohibita* are wrongs which are not wrongs of themselves, but which are prohibited by human laws; as treason, forgery, &c.

Malambo Bark. (*See* Croton.)

Mala Praxis, *mā'-la prek'-sis* (Lat.), in Law, denotes bad or unskilful practice. If the health of an individual be injured by the unskilful or negligent conduct of a surgeon, or apothecary, or general practitioner, an action for compensation may be sustained.

Malaria, and **Miasm**, *măl-ai'-re-ă*, *me'-azm* (Ital. *mala aria*, bad air, and Gr. *miaino*, I infect).—The former of these words is now generally employed to designate a cert[illegible] emanation fr[illegible] marshy ground, and the [illegible] is used in the same sense. Miasma, or miasm, by itself, denotes simply contagion (which *see*). This poison is not cognizable by the senses, nor can it be detected by chemical tests; it is known only by its effects upon the system. The observation of centuries, however, has rendered us well acquainted with the effects of this subtle poison. Marshes, whether salt or fresh, are prolific sources of malaria, especially in a certain stage of the drying process under a hot sun. But this poison is the product also of various sorts of soil; as wet meadows, grounds alternately flooded and drained, the mud left by the retiring tide in seaports and estuaries, parts covered with low and dense brushwood or with reeds and grass, a country newly cleared of its wood,—all these, particularly in warm climates, are fertile sources of malaria. The concurrence of vegetable matter susceptible of decay, of moisture, either on the surface or a short distance below it, and of a certain elevation of temperature, is necessary for its evolution; and of these long-continued heat has the greatest influence in increasing the intensity of the poison. Comparatively harmless in the northern parts of the temperate zone, it becomes malignant and deadly in places equally favourable to its production, just in proportion to the increase in the mean annual temperature. It is not necessary that the amount of vegetable matter be great, or its growth recent, since malarious diseases are often caused by the drainage of ponds and lakes; neither is the quantity of water required to be large for the generation of malaria. In tropical countries it is remarked, that the evolution of malaria commences immediately on the falling of the rain, and the sickness abates as the ground gets thoroughly wetted. A marsh completely covered with water is innocuous; it is only when the moisture is being dried up under a hot sun that it becomes pestilential. In the case of inundations, it is at their subsidence that sickness prevails. Dr. Ferguson, who was with the British army in Spain, has furnished us with many instances of the small degree of moisture that may serve to produce malaria in its most intense degree. "The army," he says, "advanced to Talavera through a very dry country, and in the hottest weather fought that celebrated battle, which was followed by a retreat into the plains of Estremadura, along the course of the Guadiana river, at a time when the country was so arid and dry for want of rain, that the Guadiana itself, and all the smaller streams, had in fact ceased to be streams, and were no more than lines of detached pools in the courses which had formerly been rivers; and there they suffered from remittent fevers of such destructive malignity that the enemy and all Europe believed that the British army was extirpated." Also, the approach to the town of Ciudad Rodrigo is through a bare, open, barren country; and on more than one occasion, when this low land, after having been flooded in the rainy season, had become as dry as a brick ground, with the vegetation utterly burnt up, there arose fevers among our troops which for malignity of type could only be matched by those before mentioned on the Guadiana.—(*On the Nature and History of Marsh Poison*, by William Ferguson, M.D., &c., Edinburgh, 1821.) As regards water, Dr. Ferguson lays it down as a rule, to which there is no exception in climates of high temperature, that the only condition indispensable to the production of the marsh poison, on all surfaces capable of absorption, is the paucity of water where it had previously recently abounded. Heat is the agent most active in the production of malaria, in all soils and situations capable of engendering it; hence, in this country, even the milder forms of malarious disease are rarely seen before the vernal or after the autumnal equinox; and wherever they exist, their prevalence is terminated by the cold of winter. It has often been observed, that a summer of unusual warmth, especially if occurring after a wet spring, causes intermittent and remittent fevers to reappear in districts whence they had long been banished by the improvement of agriculture. As a general rule, malaria is more pernicious in proportion [illegible]; but to this rule there are various exceptions. Places at some distance, especially if situated upon an eminence, are sometimes affected with the same, if not greater intensity, than places in the vicinity. The distance to which marshy emanations may extend by gradual diffusion has been calculated to be 1,400 to 1,600 feet in elevation, and from 600 to 1,000 feet in an horizontal direction; and these limits, it is said, cannot be exceeded in Europe; but in equatorial regions the activity of the poison is greater, and in the West Indies, vessels 9,000 feet from the marshy coast have felt the effects of its baneful influence. But when winds are in operation, the extent to which the poison may be transported is unknown; but instances are recorded of its being conveyed three or more miles. Though malaria is principally owing to heat, it is not in the hottest part of the day that its influence is most pernicious, but in the evening or night. Besides the more familiar effects of malaria,—intermittent and remittent fevers, there are a number of organic affections of the spleen, liver, stomach, intestines, and mesenteric glands, also dropsy, apoplexy, palsy, and idiocy, that are traced to its long-continued application; while cholera, dysentery, and diarrhœa, are referred to its more brief agency. Natives of marshy districts, who constantly reside in them, have their whole bodily and mental constitution contaminated by the poison which they inhale. Their aspect is sallow and prematurely senile; their muscles flaccid, hair lank, stature stunted, and their intellectual and moral character low and degraded. The progress of civilization and of agriculture is a principal means in diminishing the domain of malaria. In marshy situations a screen of woods has often been found of great benefit between the habitations and the marshes.

Nutritious diet, and whatever is most conducive to health, should be observed by persons exposed to the influence of malaria.—Ref. *The Cyclopædia of Domestic Medicine*, by Forbes, Tweedie, and Conolly.

MALEDICTION, *măl-e-dik'-shun* (Lat. *maledictio*), in Law, is applied to a curse which was anciently annexed to donations of lands, &c. to churches and religious houses, imprecating the most direful punishments on those who should infringe them.

MALESHERBIACEÆ, *mălz-hairb-e-ai'-se-e* (in honour of Lamoignon de Malesherbes, an illustrious French patriot and agriculturist), in Bot., the Crownwort fam., a small nat. ord. of *Dicotyledones*, sub-class *Calyciflora*, consisting of herbaceous or somewhat shrubby plants, resembling *Passifloraceæ*; but differing in never being climbers, in the want of stipules, and in some other minor characters. There are but two genera, *Malesherbia* and *Gynopleura*, which include five species, all natives of Chili and Peru.

MALIC ACID, *mai'-lik* (Lat. *malum*, an apple), a vegetable acid found abundantly in most acidulous fruits, especially in unripe apples, gooseberries, and currants. The footstalks of the ordinary garden rhubarb also furnish large quantities of it; but it is most usually obtained from the berries of the mountain ash. To prepare it, the juice of berries of the ash, or the footstalks of the garden rhubarb, are neutralized with milk of lime, a quantity of chloride of calcium being also added, to decompose the malate of potash that is always present. The liquid, which contains bimalate of lime, is filtered and boiled for several hours, until neutral malate of lime separates as an insoluble powder. The malate of lime is washed with water, and added to dilute nitric acid until it ceases to be dissolved. The liquid thus obtained is filtered and set aside to crystallize; well-defined crystals of bimalate of lime being formed. The solution of the bimalate is then decomposed with acetate of lead, and the resulting malate of lead with sulphuric acid. The syrupy solut[illegible] malic acid being set aside, deposits radiated masses of crystals, composed of four- and six-sided pri[illegible] quescent in moist air. Malic acid is dibasic, [illegible] a strong tendency to form acid salts. The bimalate of ammonia and bimalate of lime may be obtained in large well-defined crystals. The only use to which malic acid has yet been applied is in the manufacture of succinic acid by the fermentation of neutral malate of lime. Impure malate of iron has also been used in medicine. Malic acid appears to exist under two modifications, one of which exercises an influence on a ray of polarized light, the other being destitute of any such action.

MALICE, *măl'-is* (Lat. *malitia*), in Ethics and Law, is a formed design of doing mischief to another. In its common acceptation, it implies a desire of revenge, a settled anger against a particular person; but in its legal sense, it [illegible], if anything, more than merely without just cause or excuse. In murder, it is malice makes the crime, and the words *ex malitia præcogitata* (of malice aforethought, or malice prepense) are necessary to an indictment of murder. Malice prepense is either express or implied; express, when the design is evidenced by external circumstances, or even if, upon a sudden provocation, one beats another in a cruel and unusual manner, so that he dies, even though he did not intend his death; implied, as where a man wilfully poisons another, or a[illegible] kills another suddenly without any, or without a considerable provocation. In general, all homicide is malicious, and thus murder; unless justified by command or permission of the law, excused on account of accident or self-preservation, or alleviated into manslaughter by extenuating circumstances, the burden of proving any of these to the satisfaction of the court and jury being incumbent upon the prisoner. Previous to 7 & 8 Geo. IV. c. 30, an act "for consolidating and amending the laws in England relating to [illegible] injuries to property," it was necessary in such cases to prove express malice in the offender towards the owner, which frequently rendered it difficult to convict the party. This statute, however, contains an express enactment that its provisions shall equally apply and be enforced whether the offence shall be committed from malice conceived against the owner of the property in respect of which it shall be committed, or otherwise.

MALL, or PALL MALL, *mell*, or *mawl*, the name of a game formerly very popular in England. It was played by striking a box ball with a stick or mallet, through a ring or arch of iron, one of which stood at each end of an alley; and he that could do it with the smallest number of blows was victor. The game of mall, says Strutt, was a fashionable amusement in the reign of Charles II., and the walk in St. James's Park, known as the Mall, received its name from having been appropriated by the royal party to this game. At an earlier period, the site of the street now called Pall Mall was used for this purpose. The name mall seems to have been given to the game itself from the mallet with which the ball was struck, and pall mall to the ground or alley on which it was played.

MALLEABILITY, *măl-le-ă-bil'-e-te* (Lat. *malleus*, a hammer), a property possessed by some bodies, especially metals, which renders them capable of being beaten out with the hammer or converted into plates between rollers. Gold is extremely malleable; it can be beaten 1,200 times thinner than ordinary writing-paper. Iron has been rolled into sheets the 3,500th of an inch in thickness, and a square inch of the leaf only weighed three-quarters of a grain.

MALLEUS, *măl'-le-us*, in Anat., is a term applied to one of the bones of the ear, from its resemblance to a mallet. (*See* EAR.)

MALLOW. (*See* MALVA and ALTHÆA.)

MALPIGHIACEÆ, *măl-pig-e-ai'-se-e* (in honour of Marcello Malpighi, an Italian naturalist), in Bot., the *Malpighia* fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, having the following essential characters:—Trees or shrubs with simple stipulate leaves. Flowers perfect or polygamous. Calyx and corolla with five parts; the sepals having usually large glands at the base, and imbricated or very rarely valvate; the petals unguiculate, without appendages, hypogynous and convolute. Stamens usually 10, sometimes 15, with a fleshy prolonged connective. Ovary usually [co]mposed of 3 carpels (rarely 2 or 4) partially or [illegible] combined, ovules solitary, pendulous from long [illegible] Seeds exalbuminous, usually with convolute embryo. The plants of this order are confined to tropical climates. Some have edible fruits, as the species *Malpighia glabra* and *punicifolia*, which yield the [Bar]badoes cherries, others are chiefly remarkable for their large and showy flowers; while some are interesting to the botanist on account of their anomalous stems, the peculiarity of which consists in the presence of several woody axes without annual zones. The order is generally characterized by astringency. Lindley enumerates 43 genera and 556 species.

MALT, *mawlt* (Sax. *mealt*).—In its general sense, this word signifies any grain which has become sweet in taste on account of the commencement of germination. In a more restricted sense, it signifies the preparation of barley from which ale, beer, and porter are brewed, all of which are called *malt liquors*. In order to convert it into malt, barley is steeped in water for three or four days; it is then taken out and suffered to lie [illegible] until it begins to sprout, or germinate. It is afterwards dried in a kiln and treated with boiling water, in order to form *wort*, as explained in the art. BREWING. By being converted into malt, barley increases two or three per cent. in bulk, and loses, on [illegible], 20 per cent. in weight, of which 12 are [illegible] kiln-drying, and consist of water which the barley could not have lost had it been exposed to the same temperature: so that the real loss does not exceed 8 per cent. The roots appear, from the process, to be formed chiefly from the mucilaginous and glutinous portions of the kernel. The starch is not employed in their formation, but acquires a sweetish taste and the property of forming a transparent solution with hot water. It approaches, in fact, somewhat to the nature of sugar. The peculiar manner to which malt is subjected to duty has given rise to most of the changes which have occurred in the malt trade. In England the malt duty began [in] 1697; in Scotland in 1713; and in Ireland in 1785. From 1716 to 1816 there was apparently no increase in the quantity of malt made in England; 24,000,000 being the quantity per annum. This was caused principally by the duty and restriction, and partly by the growing taste for tea and coffee. The duty rose from 6*d.* in 1702, to 4*s.* 6*d.*

in 1804. The present duty on barley-malt is about 2*s.* 6*d.* In 1859, the quantity of malt paying duty was 40,406,447 bushels; 548,743 bushels, however, over and above this quantity, were rendered exempt from duty on various grounds.

Maltese Terrier. (*See* Terrier.)

Malthusian Doctrine, *măl-thu'-ze-ăn*, in Pol. Econ., is the name commonly given to a doctrine advanced by the Rev. T. R. Malthus, which has given rise to much discussion among economists. The doctrine, in brief, is that there is a tendency in population to increase faster than the means of subsistence, hence the pressure of population against subsistence may be expected to become greater and greater in each successive generation (unless new and extraordinary remedies are resorted to), and thus to produce a progressive diminution of human welfare. "There are few states," he says, "in which there is not a constant effort in the population to increase beyond the means of subsistence. This constant effort [illegible] tends to subject the lower classes of [illegible], and to prevent any great permanent [illegible] of their condition." This is just one of those cases in which theory ignores facts. What, for instance, is the picture presented by the earliest records of those nations which are now civilized, but a scanty population and still scantier means of subsistence. As civilization extends, the population increases, but the means of subsistence increases at a greater rate. In every civilized country there will be found to be much less poverty than is universal in the savage state; and hence it must be true that, under the circumstances in which that country has been placed, the means of subsistence have a greater tendency to increase than the population. (*See* Population.)—*Ref.* Senior's *Political Economy.*

Malva, *mal'-vă* (Lat.) the Mallow, the typical gen. of the nat. ord. *Malvaceæ.* The species *M. sylvestris* is the common mallow, a handsome plant with large purplish flowers, growing at roadsides and in waste places. The French name for the plant, *mauve*, has of late been applied to a delicate shade of purple. The bark of the mallow yields strong fibres. The root and leaves have similar properties to those parts of the marsh-mallow. (*See* Althæa.) The petals of the species *M. alcea* have astringent properties, and yield a black dye.

Mamelukes, or **Memlooks**, *măm'-ĕ-looks*, *mem'-looks* (Arab. *memalik*, a slave), is the name given to a body of soldiery who ruled Egypt for several centuries. They were introduced into that country by the sultan Malek Salech about the middle of the 13th century, being Asiatic youths, chiefly from the Circassian region, purchased as slaves from Gengis Khan, whose captives they were. These were trained to military exercises and formed into a corps of 12,000 men, called Memlooks. They soon exhibited a spirit of insubordination, and, in 1254, assassinated the sultan Turan Shah, successor of Malek Salech, and raised Eybek, one of their own number, to the throne. A line of sultans, known as the Bahree, or T[illegible] followed, all of whom were raised to power by the Mamelukes, and many of them deposed and slain. This dynasty conquered Syria, took Damascus, and put an end to the domination of the Abbaside caliphs. In 1382 the Bahree dynasty was overthrown by a new band of Mamelukes called Borghees, from a word signifying a castle, because they were first employed in garrisoning the fortresses of Egypt. They made their commander, Doulet-el-Memlook, sultan; and this dynasty continued to rule the country till 1517, when they were subdued by the Ottoman Turks, and Egypt became a dependency of Constantinople. The Turkish sultan, however, did not deprive the Mamelukes of all power, but maintained them as a military aristocracy in the country. He divided Egypt into twenty-four provinces, each of which was placed under the jurisdiction of a Mameluke bey or chief; and this body served as a check upon the pasha, to whom the general government of the country was intrusted. The beys had also the right to elect the Sheik-el-beled, or governor of Cairo, an officer of great power. The beys soon after the Turkish conquest contrived to obtain such influence and power, that eventually they became the virtual rulers of Egypt, while the viceroys had only the shadow of rule. Each of the twenty-four beys maintained 500 or 600 followers, magnificently armed and equipped. The office of bey was not hereditary, but elective. This state of things continued till Bonaparte's invasion of the country in 1798. At the battle of the Pyramids, July 21st, 1798, the Mamelukes mustered in great force and attacked the French with desperate courage, but were repulsed with terrible slaughter, their broken and dispirited remains, about 2,500 in number, fleeing into Upper Egypt. After the French were driven out of the country, the Mamelukes regained some degree of power; but the Turks, dreading their return to their former position, did what they could to oppose them, and on more than one occasion had recourse to treacherous massacres of them. The final blow, which utterly destroyed them as a military or political body, was struck by the pasha Mehemet Ali, who, on March 1st, 1811, invited their chiefs and principal men, to the number of 470, to a conference in the citadel of Cairo, and then, closing the gates, ordered his Albanian soldiers to fire upon them. Only one escaped, by leaping his horse from the ramparts, and alighting unhurt, though the horse was killed by the fall. Immediately after a general massacre of the Mamelukes was ordered in every province; a few escaped into Dongola, where they subsequently dispersed themselves; and as a body they are now extinct.

Mammalia, *mam-ma'-le-ă* (from Lat. *mamma*, the breasts).—This important class in Zoology, which has been placed by Linnæus at the head of the vertebrated series in the [illegible] kingdom, includes all such animals as are pr[illegible] for suckling their young. Even excluding man, who necessarily belongs to the class, we find amongst the *mammalia* the greatest number of faculties, the most delicate sensations, the most varied action, and an extraordinary aggregate of properties for the production of intelligence; there is every reason, therefore, for Linnæus having classed the mammalia as first amongst animals. They are most fruitful in resources, least subject to mere instinct, and, finally, most susceptible of progressive improvement. With but a moderate amount of respiration, they are generally intended for locomotion by walking with strength and continuity; and hence all the articulations of their skeletons have the forms very exact; thereby determining, with unvaried precision, the nature of their movements. Some fly through the air by means of membranes affixed to their limbs, although typically adapted for walking on the earth; while others have the extremities so short that they move with ease only in the water, both of these exceptions retain, however, in all other respects, as a rule, the general characteristics of their class. It may be here stated that all mammalia are endowed with warm blood, which results from the great development of their respiratory apparatus; the heart being double, and containing four cavities; that is to say, an auricle and ventricle on the right side, and the same on the left. The circulation is carried on in the following manner. The venous blood passes through the cavities on the right side and is distributed through the lungs, where it combines with the oxygen or vivifying portion of the air; it is then conveyed by the pulmonary veins to the left auricle, from whence it flows into the ventricle, and is propelled through the arterial system. (*See* Heart.) The females suckle their young with milk secreted in breasts or *mammæ*, and are viviparous, or ovo-viviparous; they are consequently placental or implacental, the placental including the higher order of mammals, from man to the last true rodent, and the implacental composing the marsupialia and monotremata. Both of these divisions have the upper jaw fixed to the skull, and the lower is formed of but two pieces only, and is articulated to the temporal bone. The neck (to pursue our investigation) is composed of seven vertebræ; but in different descriptions of animals some of these bones are either more or less in number; the anterior ribs are affixed to the sternum, or breastbone, by cartilaginous processes. The anterior extremities of these commence with a shoulder-blade which is not articulated but rests between the muscles, and often, indeed, leans on the sternum by means of the clavicle on each side. This is continued by an arm, forearm, and hand. The latter is formed of two rows of bones, called the *carpus*, a third row,

called the *metacarpus*, and fingers, each consisting of two or three joints. With the exception of the cetacea, or whale family, all mammalia have the pelvis attached to the spine; the pubes forming the anterior, and the ilia, ischia, sacrum, and coccyx, the lateral or posterior parts. At the point where the first three mentioned bones unite, on each side, is the articulation of the femur, or thigh-bone, to which are attached the leg-bones, tibia, and fibula, which are in most cases distinct; and are succeeded by those composing the foot, which correspond to the bones of the hand; namely, a tarsus, metatarsus, and toes. In different orders and genera of animals, the extremities vary considerably; in some, those of the fore parts are considerably lengthened, so as to form the supporters of a wing,—as in bats; in others, they are shortened, as is evinced in the jerboa and kangaroo; while in both of these last-mentioned varieties the posterior extremities are enlarged in the apparently greatest disproportion. The cetacea and similar animals, which have been briefly alluded to, have no pelvis whatever; their hinder extremities are likewise wanting; they are, however, supplied, instead of these, at the end of the spine or vertebral column with cartilaginous bodies forming a kind of feet, [illegible] the flukes of the tail, which, in this species, is alwa[illegible] horizontally placed. The fore-foot (*metatarsus*) usually counts as many bones as there are toes present. The metatarsus in the ruminant and solidungulate animals is conformable to the metacarpus. In the genus Dipus (the jerboa), [illegible] the three middle metatarsal [illegible] a single bone, which terminates below in three processes, to which the three large toes are connected, and which thus resembles the principal bone at the root of the foot in birds. The digits of the foot in the ruminants, the solid ungulates, and commonly, also, in the pachyderms, correspond in number and form to those of the hand. Such, also, is the case in most of the carnivorous animals, although in the genera *Felis* and *Canis* the thumb (pollex) of the hind foot is not developed, of which a trace only is observed in the fore foot. In the monkeys the thumb is shorter, but the other digits are longer than in the human foot. The head is, in all mammalia, articulated by [illegible] upon their atlas or first vertebra. As the [illegible], it has excited the greatest interest in all ages, and it has been remarked, that the approach to [illegible] observed in animals bore some relation to the size and configuration of the head. The brain is the centre or origin of the nervous system, and will be found fully described under an article bearing that name. (*See* EAR and EYE.) The tongue of mammals is always fleshy, and is attached to a bone termed the [illegible], which is composed of several pieces, and suspended to the [illegible]. The lungs are two in number, and are divided into lobes, which are composed of an immense quantity of small cells; they are suspended without adhesion in a cavity formed by the rib and diaphragm, and lined by the pleura. The skin of mammals is, as a rule, usually covered with hair. [illegible] however, have horny pl[illegible] tribe *Manis*, or horny plates, as the armadilloes (the genus *Dasypus*); and, indeed, some have spines. The sense of touch is variously developed in the extremities of the limbs in the different species, according as the feet move only for progression, for standing, or for seizing alone. In the apes, which appear to be in this respect one of the most privileged, the hand is much less adapted for feeling than in man, who, in his erect position, can move and apply his fore limbs for the sense of touch more easily. The whiskers which [illegible] attached to the lips serve also, like the fleshy appendages attached to the jaws of some fishes, to give warning of external obstacles, on account of branches from the fifth pair of nerves being attached to their roots. The motions of mammals consist principally in progressing. Some are able to spring to great heights; others, again, are formed for swimming. In the cetaceans, or whales, swimming is the sole means of motion. Other mammals are able to fly, as was stated before, by means of a membranous substance below the elongated fingers of the four limbs; like the bats for instance. With regard to the physical distribution of this class of animals much might be said. Some reside entirely in the sea, as the cetaceans and most of the seals. (*See* SEAL FAMILY.) Although some species, especially of the animals last named, live in fresh water, many varieties of the genus *Sorex*, the otters, beavers, and the duck-mole, reside in lakes and rivers. Others, again, live under ground, as the family *Talpa* and *Bathyergus*. The greater part, however, live on land,—some on high mountain-tops; as the antelope, ibex, &c.; others on trees, as the apes, squirrels, and monkeys; and some resort, by flying and flapping in part, even to the air (the *Galeopithecus* and *Cheiroptera*). This difference of resort is naturally in relation with the general bodily form of the animal, and the constitution of its various parts, especially of the organs of motion and sense. In the geographic distribution of the mammalia, it may be as well stated that the numbers of its various classes increase from the pole to the equator,—as well the various classes as the sub-genera; although the cetaceans and seals must be excepted from the rule. There are species in the north polar regions, to quote the remarks made use of in Van der Hoeven's "Handbook of Zoology," common to the old and new world; as *Canis lagopus*, *Ursus maritimus*, and *Cervus tarandus*; without the polar circle, also, some species are found in the northern countries of both hemispheres, as *Mustela Martes*, *Mustela erminea*, and *Castor Fiber* (some writers, indeed, maintain that the beaver of America is specifically different from that of the old world). In the temperate parts of North America, almost all the species are such as do not appear in the eastern hemisphere; while in South America no single species is found which also lives in the old world,—nay, even the genera differ for the most part from those of the old world. South American genera, of which no species in the old world are hitherto known, are the following,—*Dicotyles*, *Auchenia*, *Dasypus*, *M[illegible]*, *Bradypus*, *Cavia*, *Loncheres*, *Nasua*, the genera of the bat tribe; *Glossophaga*, *Phyllostoma*, *Molossus*, *Noctilio*, and many genera of Quadrumanes; namely *Callithrix*, *Ateles*, *Mycetes*, *Pithecia*, and *Hapale*. *Procyon* is peculiar to the new world in the northern and southern hemispheres. *Fiber* is an animal form of North America. Other genera are peculiar to the eastern hemisphere, as *Sus*, *Equus*, *Camelus*, *Rhinoceros*, *M[illegible]*, *Spalax*, *Cricetus*, *Viverra*, *Herpestes*, *Erinaceus*, the genera of bats, *Megaderma*, *Nycteris*, *Rhinolophus*, *Pteropus*, the family of the *Lemurida*, the genera of the apes; *Cercopithecus*, *Semnopithecus*, *Inuus*, *Cynocephalus*, *Hylobates*, *Simia*. To Africa, in [illegible] the genera *Camelopardalis*, *Hippopotamus*, *Orycteropus*, *Cercopithecus*; while in a similar manner to the island of Madagascar are pe[illegible] the *Cheirogaleus*, *Lemur*, *Lichanotus*, and the genus *Cheiromys*, a semian rodent which approaches the *Lemurida* in form. Most of the species of antelopes are also exclusively African. Most of the *Marsupial* species are found in Australia and the adjoining islands, while the genus *Didelphys* alone is American,—Africa, as well as Europe, not possessing a single species of this division. If we take into consideration the entire class of mammals, exclusive of the *Cet[illegible]* [illegible] then the *Rodents* will be found to form one-third of the entire number of species, the *Carnivores* and *Cheiroptera* together about one-third also, [illegible] is formed, for the greater part, [illegible] *Q*[illegible] and Ruminants; and [illegible] Marsupials and insectivorous *feræ*. W[illegible] of some species of bats and of the true whale. Mammals are not tied, like birds of passage, to make strictly limited migrations; but inhabit the same districts in winter and summer both. On the other hand, different species hybernate, and pass a greater or less portion of the year without food in caves and hiding-places. Amongst such in Europe are, for example, the bat, the hedgehog, the hamster, the marmot, and various other species of rodents, forming the genus *My*[illegible] and in the north the bears. (*See* article on HYBERNATION.) With reference to the classification and division of animals of the section *Mammalia*, that proposed by Cuvier is undoubtedly one of the best, if not the best, *par excellence*, as it possesses many advantages over that adopted by Linnæus. In the present article, therefore, Cuvier's system has been followed; and the great naturalist himself gives an outline of his object and reasons in the last edition of

his "Animal Kingdom." The following are his words:—"The characters by which Mammalia differ most essentially one from another, are derived from the organs of touch, from which results their degree of dexterity, and from the organs of mastication, which determine the nature of their food; and upon these very closely depends not only everything which is connected with the digestive functions, but a variety of other circumstances relative even to their degree of intelligence. The perfection of the organs of touch is estimated by the number and mobility of the digits, and the extent to which they are inclosed in a claw or hoof. A hoof which completely incloses that part of the digit which touches the ground, precludes the exercise of it as an organ of touch or prehension. The opposite extreme is where the nail, in the form of a single lamina, covers only one side of the end of the digit, leaving the other side in possession of all its delicacy of touch. The kind of food is indicated by the molar teeth, to the form of which the articulation of the jaws invariably corresponds. For cutting flesh, the molar teeth must be trenchant and serrated, and the jaws fitted together so as to move like the blades of a pair of scissors, simply opening and closing in the vertical direction. For bruising grains and roots, the molar teeth must have flattened crowns, and the jaws a horizontal motion; and further, that the grinding surface may be always unequal, like a millstone, the teeth must be composed of substances of different degrees of density, and consequently wearing down in different proportions." (With regard to this last-mentioned peculiarity, *see* art. HORSE.) Cuvier's arrangement is as follows:—

Class MAMMIFERES.

Order I. BIMANA.—Man.

Order II. QUADRUMANA.—Two families:—1. Apes and Monkeys; and 2. *Macaucos* (*Lemur*, according to Linnæus).

Order III. CARNASSIERS.—Family 1. *Cheiroptera* (Bats).—2. *Insectivora* (Hedgehogs, Tenrecs, *Tupaia*, Shrews, *Mygale*, *Chrysochloris*, *Talpa*, *Condylura*, *Scalops*).—3. *Carnivora*. Tribe 1. *Plantigrades*: Bears, Raccoons (*Procyon*), *Panda*, *Benturongs*, Coatis (*Nasua*, Storr.), [illegible] Badgers, Gluttons, Ratels. Tribe 2. *Digitigrades*: Martens, Skunks, Otters, Dogs, Civets, Genets, *Paradoxurus*, *Ichneumons* (*Herpestes*, Illiger), Suricates, *Crossarchus*, *Proteles*. The last subdivision of the Digitigrades is composed of the Hyænas and the Cats, in which last the sanguinary development is at its height. Tribe 3. *Amphibia*: the Seals (*Phoca*, Linn.), and the Walruses (*Trichecus*, Linn.).

Order IV. MARSUPIALIA.—Subdivision 1. Opossums, Dasyurus, *Perameles*. Subdivision 2. *Phalangista*. Subdivision 3. The Kangaroo Rats (*Hypsiprymnus*, Illiger), the Kangaroos, the Koalas, and the *Phascolomys*.

Order V. RODENTIA.—The Squirrels (*Pteromys* and *Cheiromys*, Cuvier), *Echimys*, *Hydromys*, Capromys, the Rats proper, the Jerbilles, *Meriones*, the Hamsters, *Cricetus*, and *Arvicola*, the Rats, the Sousik, *Myoxus*. Also the Field Mice and Rats, the Lemmings, the Jerboas (*Dipus*), the Beavers, the Porcupines, the Hares (*Lepus*, Linn., including the *Lagomys* of Cuvier), the *Capybara*, the Guinea-pigs, the Agoutis (*Chloromys*), the Pacas, and the Chinchillas.

Order VI. EDENTATA.—Tribe 1. *Tardigrades*: the Sloths (*Bradypus*, Linn.). Tribe 2. Ordinary *Edentata*: the Armadilloes (*Dasypus*, Linn.) and the subgenus *Chlamyphorus*, the Aard-Vark and the Ant-eaters, the Pangolins (*Manis*, Linn.). Tribe 3. The Monotremes, the *Echidna*, and the *Ornithorhynchus* (*Platypus*, Shaw).

Order VII. PACHYDERMATA.—Family 1. Proboscidians: Elephants and Mastodons. Family 2. Ordinary *Pachydermata*: the Hippopotamus, the Hogs, the Rhinoceroses, the Damans (*Hyrax*), and the Tapirs. Family 3. *Solipeda*: the Horses, &c. (*Equus*, Linn.).

Order VIII. RUMINANTIA.—1. No horns: the Camels, including the Llamas, and the Musks. 2. True horns, shed periodically: the Stags or Deer (*Cervus*, Linn.). 3. Persistent horns: the Giraffe. 4. Hollow horns: the Antelopes, the Goats, the Sheep, and the Oxen.

Order IX. CETACEA.—Family 1. Herbivorous *Cetacea*: the Manatees, the *Dugongs*, and the Rytina (Illiger). Family 2. Ordinary *Cetacea*: the Dolphins and the Porpoises, the Narwhals (*Monodon*, Linn.), the Cachalots, and, finally, the Whalebone Whales (the *Balæna* of Linnæus, including the *Balænoptera* of Lacépède).

The above is a digest of the classes as given in Cuvier's last edition of the "Règne Animal." Amongst the ungulate animals, according to Cuvier, the first is Man, and the order which comes nearest to Man is termed the *Quadrumana*,—*i. e.*, has hands on the four extremities. Another order, termed the *Carnivora*, has not the thumb free. Those animals whose digits are much sunk, and which are distinguished by the absence of incisor teeth, are called *Edentata*. The *Ruminantia*, by their cloven feet, their want of upper incisor teeth, and by their complicated stomach, form an entirely separate class to themselves. All other quadrupeds with hoofs might be united into a single order, which, according to the French naturalists, might be called *Pachydermata*, or *Solipeda*, the elephant alone excepted, having some remote affinities to the order Rodentia. In the last degree in the scale of mammals come those which have no hinder extremities, and whose fish-like form and entirely aquatic habits would lead us to place them in some separate class, if it were not that their domestic economy is in all respects perfectly similar to the class in which they are catalogued. These are the warm-blooded fishes of the ancients, and the *Cetacea* of our naturalists; and they combine the powers of other Mammalia with the faculty of suspending themselves in or upon the sea; they consequently appear to possess double advantages. In the affinities between the various classes of Mammalia, the different species will be seen to descend in a corresponding ratio as they diverge from the *Quadrumana*; so, as it is well observed in an article on the subject in Brande's Dictionary, "the scheme may be likened to a cone, of which Man is the culminating pinnacle."—*Ref.* Cuvier's *Animal Kingdom*, Professor Owen's Works; Hoeven's *Handbook of Zoology*; the *English Cyclopædia*—Natural History; &c. &c. (*See* also separate articles on the various classes.)

MAMMEA, *măm-me'-a* (*mamey* is the aboriginal name of the species), in Bot., a gen. of the nat. ord. *Guttiferæ*. The species *M. americana* produces the fruit called the mammee apple, or wild apricot of South America, which has a most delicious flavour. From the flowers a kind of brandy is distilled, and the sap when fermented forms a wine. The seeds are anthelmintic.

MAMMON, *măm'-mon*, is the name of the Syrian god of riches, and is mentioned in the teachings of Christ as a personification of worldliness. Milton makes him a fallen angel, and Spenser has personified him in his boldest manner in the "Faërie Queene" (book ii. canto 7), where he represents Sir Guyon amid the secret treasures of the "god of the world and worldliness."

MAMMOTH, *măm'-moth* (*Elephas primigenius*), the Russian name for an extinct species of elephant, the bones of which resemble those of the existing Asiatic species, but whose grinders have the ribands of enamel narrower and straighter, the alveoli of the tusks longer in proportion, and the lower jaw more obtuse. The mammoth was thickly covered with hair of three different kinds; one consisting of stiff black bristles a foot in length; another of coarse flexible hair, and the third of a kind of wool. The bones and tusks of the mammoth are found throughout Russia, and more particularly in Eastern Siberia and the Arctic marshes, &c. The tusks form an article of commerce, and are much used in making the inferior kinds of ivory goods. In Siberia, during 1799, a whole mammoth was discovered by a Tungusian, named Schumachoff, with the whole of the soft parts preserved in the snow. Schumachoff, who generally went to hunt and fish on the peninsula of Tumut after the fishing season of the Lena was over, erected a cabin for his wife on the bank of the the Oncone, and then embarked to search along the coasts for mammoth tusks. One day he saw among the blocks of ice a shapeless mass, but did not then discover what it was. In the course of the next year, he saw that this object was more disengaged from the ice, and that it had two projecting parts; towards the end

of the summer of 1801, the entire side of the animal and one of his tusks were quite free from ice. The summer of 1802 was cold; but in 1803, the ice between the earth and the mammoth having melted more rapidly than the rest, the plane of its support became inclined, and the enormous mass fell by its own weight on a bank of sand. Dogs and wild beasts soon devoured most of the flesh; but it was found to be a male, with a long mane on the neck, but without tail or proboscis, both having been probably devoured. It is asserted that the places of the insertion of the muscles of the proboscis were visible in the skull. The entire carcass was 9 feet 4 inches high; 16 feet 4 inches long, from the point of the nose to the end of the tail, without including the tusks, which were 9 feet 6 inches, measuring along the curve. The two tusks together weighed 360 lb avoirdupois, and the head, with the tusks, 414 lb. Remains of the *Elephas primigenius* have been found in large quantities in the British isles. They have been found off the coasts of Norfolk and Suffolk, and in many parts of Essex; at Herne Bay, in the valley of the Thames; at Sheppey, Lewisham, Woolwich, and the Isle of Dogs. They have been dug up in the streets of London, as in Gray's Inn, and in Charles Street, St. James's Square. They have also been dug up at Kensington, Kew, Henley Bottom, Wallingford, and Dorchester. They have also been found at Brighton, and in districts of Worcestershire, Warwickshire, Staffordshire, Northamptonshire, Yorkshire, and the celebrated cave at Kirkdale

MAN, *măn* (Ger. *Mann*, Fr. *homme*, Lat. *homo*, Gr. *anthropos*), is the highest and noblest of all created beings that inhabit this earth,—incontestably the lord of the creation. Him all other creatures serve, by him even the elements are brought into subjection He alone possesses the power of adapting himself to the most opposite circumstances, and he alone is found to be improving his condition generation by generation. Considered as an object of natural history, man is a mammiferous animal belonging to the order *Bimana*, or two-handed, of which he constitutes the sole genus *Homo*. The distinguishing characteristics of man are two hands, the erect posture, teeth approximated and of equal length, the inferior incisors perpendicular, prominent chin, rational, endowed with speech, unarmed, defenceless. "That," says Cuvier, "which constitutes the *hand*, properly so called, is the faculty of opposing the thumb to the other fingers, so as to seize upon the most minute objects; a faculty which is carried to its highest degree of perfection in man." The next series of characters are those by which he is by nature adapted to the erect posture, the head nicely balanced on the summit of the vertebral column, and the muscles of the trunk and limbs which contribute to the maintenance of the erect posture, largely developed. The face is placed immediately beneath the brain, so that its front is nearly in the same plane as the forehead, which is peculiarly characteristic of man. The vertebral column in man has its curves so arranged that when the body is in an erect posture a vertical line from its summit would fall exactly on the centre of its base; and it increases considerably in size in the lumbar region. The lower extremities in man are remarkable for their length, which is proportionally greater than in any other mammal except the kangaroo The human foot is, in proportion to the size of the body, larger, broader, and stronger than that of any other mammal save the kangaroo; and hence man alone has the power of standing upon one foot. The brain of man does not differ so much in conformation from that of the higher mammals, as the superiority of his mental endowments might have led us to anticipate. (*See* BRAIN.) The absence of any natural weapons of offence and of direct means of defence are remarkable characteristics of man, and distinguish him from even the most anthropoid of apes, whose enormous canines have no relation to a carnivorous regimen, but are instruments of warfare. The slow growth of man, and the length of time during which he remains in a state of dependence, are also peculiar to him. He also possesses, in a remarkable degree, the power of adaptation to varieties in external condition which renders him in a great measure independent of them. He is capable of sustaining the highest as well as the lowest extremes of temperature and of atmospheric pressure, and of subsisting on a great variety of food. But most of all is man distinguished from other animals by those mental endowments, and by the habitudes of life and action thence resulting, which must be regarded as the essential characteristics of humanity. It is in adapting himself to the conditions of his existence, in providing himself with food, shelter, weapons of attack and defence, &c., that his intellectual powers are first called into active operation; and when thus aroused, their development has no assignable limit. The capacity for intellectual progress is one of the most remarkable peculiarities of man's physical nature. The power of articulate speech, which, so far as we know, is peculiar to man, is one of the most important aids in the use and development of the human mind. But the mainspring of human progress may be said to lie in that aspiration after something nobler and purer which is peculiar to the human race, and which is connected with another element in his nature which it is difficult to isolate or define, but which enters, penetrates, and blends with his whole physical character It is the soul, in whatever way we may define it, which seems to constitute the distinctive peculiarity of man. — (Carpenter's *Principles of Human Physiology*.) "Man," says Professor Green, "is unquestionably endowed with that structure the perfection of which is revealed in such a balanced relation of the parts to a whole as may best fit it for a being exercising intelligent choice and destined for moral freedom. It is not, therefore, an absolute perfection of the constituents singly, but the proportional development of all, and their harmonious constitution to one, for which we contend; a constitution which implies, in a far greater degree than in any other animal, a balanced relation of the living powers and faculties, and which requires, therefore, in man, pre-eminently, the endowment of rational will as necessary for the control and adjustment of the balance Man has not the quick hearing of the timid herbivorous animals; but it was not intended that he should catch the sound of distant danger and be governed by his fears: he has not the piercing sight of the eagle nor the keen scent of the beast of prey; but neither was man intended to be the fellow of the tiger or a denizen of the forest. Hence the departure from the perfect proportion of man, which we observe in the inferior animals, may be regarded as deformities by exaggeration or defect, dependent upon a preponderance of a part that necessitates a particular use, or the absence of a part that deprives the animal of a power." 'Protrude the jaws, you have a voracious animal; lengthen the ears, timidity is expressed; let the nose project, and the animal is governed by its scent; enlarge the teeth, and you are reminded of the animal appetites." ([illegible]) The plan of our work does not require that we should say more here on the subject of man, seeing that the various particulars regarding him are taken up in their alphabetical order. Under ETHNOLOGY, for instance, will be found an account of the different races; HISTORY and CIVILIZATION give an account of the progress of the race; COMMERCE, &c, an account of the different social institutions; LAW, POLITICAL ECONOMY, &c., the laws that regulate the social system. Regard we man as an individual, his physical structure, with its wonderful application of bone and muscle, nerves, blood-vessels, &c., is treated of under ANATOMY; its growth and development, from infancy to age, fall under PHYSIOLOGY; the means by which he may be brought into the highest state of perfection of which his nature is capable, belong to EDUCATION; his moral nature is treated of under ETHICS; his intellectual under PSYCHOLOGY and METAPHYSICS; LOGIC deals with the laws of thought; PHILOLOGY with the principles of language. As a being endowed with a religious sense and a capacity for worship, he is treated of under THEOLOGY and CHRISTIANITY. These may be said to regard man in a state of health. In a diseased condition, we have PATHOLOGY, SURGERY, DISEASE; together with an account of the different diseases, which are to be found under their proper heads; as INSANITY and the like.

MAN AS A MAMMAL.—The precise position of man in the system of mammals has long been, and still remains, a subject of discussion. There are those

who regard him as too remote from all other species of the class to be subject to the ordinary principles of classification. But zoologists, generally, place him either in an independent order (or sub-class, if the highest divisions be sub-classes), or else at the head of the order containing the quadrumana. Science in searching out the system in nature leaves psychical, or intellectual qualities, out of view; and this is right: it is also safe; for these immaterial characteristics have, in all cases, a material or structural expression; and when this expression is apprehended and its true importance fully admitted, classification will not fail of its duty in recognizing the distinctions they indicate. Cuvier, in distinguishing man as of the order *Bimana*, and the monkeys of the order *Quadrumana*, did not bring out to view any profound difference between the groups. The relations of the two are so close that man, on this ground alone, would be far from certain of his separate place. No reason can be derived from the study of other departments of the mammals, or of the animal kingdom, for considering the having of two han is a mark of superior rank to the having of four. Professor Owen, in his recent classification of mammals, makes the characteristics of the brain the basis of the several grand divisions; but, as he admits, the tinctions fail in many cases of corresponding to the groups laid down; and although the brain of man (his group *Archencephala*) differs in some striking points from that of the quadrumana, yet no study of the brain alone would suggest the real distinction between the groups, or prove that man was not coordinal with the monkeys. In fact, the nervous system is a very unsafe basis of classification below the highest grade of sub-divisions—that into sub-kingdoms. The same sub-kingdom may contain species with and without a distinct nervous system, and a class or order may present very wide diversities as to its form and development, for the reason that the system or plan of structure in species is far more authoritative in classification than the condition of the nervous system. The fitness of the parts of the body of man for intellectual uses, and his *erect* position, have been considered zoological characteristics of eminent importance, separating him from other mammals But even these qualities, although admitted to be of real weight, are not to many zoologists unquestionable or authoritative evidence on this point. But while the structural distinctions mentioned may fail to establish man's independent ordinal rank, there is a characteristic which appears to be decisive,—one which has that deep foundation in zoological science required to give it prominence and authority. The criterion referred to is this,—that while all other mammals have both the anterior and posterior limbs of locomotion, in man the anterior are transferred from the *locomotive* to the *cephalic* series. They serve the purposes of the *head*, and are not for locomotion. The *cephalization* of the body—that is, the subordination of its members and structure to head uses,—so variously exemplified in the animal kingdom, here reaches its extreme limit. Man, in this, stands *alone* among the mammals. The author has shown elsewhere that this cephalization is a fundamental principle as respects grade in zoological life. He has not only illustrated the fact, that *concentration of the anterior extremity of the body, and abbreviation of its posterior portion* is a mark of elevation; but further than this, that *the transfer of the anterior members of the thorax to the cephalic series* is the foundation of rank among the orders of Crustaceans. In the highest order of this class, that of the *Decapods* (containing crabs, lobsters, shrimps, &c.), *nine* pairs of organs out of the *fourteen* pertaining to the head and thorax, belong to the head,—that is to the senses and the mouth. In the second order, that of the *Tetradecapods*, there are only seven pairs of organs out of the fourteen thus devoted to the head, two of the pairs which are mouth-organs in the Decapods being true legs in the Tetradecapods In the third or lowest order—that of the *Entomostracans*—there are only *six*, *five*, or *four* pairs of cephalic organs; and besides, these, in most species, are partly pediform, even the mandibles having often a long foot-like branch or extremity; the antennæ also being sometimes organs of prehension or locomotion. Two of the laws bearing on grade, under this system of cephalization or decephalization, have been stated; its connection with a concentration of the anterior extremity and abbreviation of the posterior extremity, and the reverse; and with a transfer of thoracic members to the cephalic series, and the reverse. There is a third law which should be mentioned to explain the relations of the Entomostracans to the other orders; namely, that a decline in grade, after the laxness and elongation of the anterior and posterior extremities have reached their limit, is further exhibited by a *degradation* of the body, and especialy of its extremities. In the step down from the Decapods to the Tetradecapods there is an illustration of this principle in the eyes of the latter being imbedded in the head instead of being pedicellate. In the Entomostracans the elongated abdomen is destitute of all but one or two of the normal pairs of members,—not through a system of abbreviation, as exhibited in crabs, but a system of *degradation*; and in some species all the normal members are wanting, and even the abdomen itself is nearly obsolete. Again, the two posterior pairs of thoracic legs are wanting in the species, and sometimes more than two pairs. Again, at the anterior extremity one pair of antennæ is *often obsolete*, and sometimes the second pair nearly, or even quite so. The *Limulus*, though so large an animal, has the abdomen reduced to a straight spine, and the antennæ to a small pair of pincer legs, while all the mouth-organs are true legs, the whole structure indicating an extreme of degradation. In the order of Decapods having nine as the normal number of pairs of cephalic organs, the species of highest group have these organs compacted within the least space consistent with the structure of the type; in those a grade lower the posterior pair is a little more remote from the others, and begins to be somewhat pediform; a grade lower, and this pair is really pediform, or nearly like the other feet; and still lower, two or three pairs are pediform. Still lower in the series of Decapods (the Schizopods) there are examples under the principle of *degradation* above explained: (1) in the absence of two or three pairs of the posterior thoracic appendages; (2) in the absence or obsolescence of the abdominal appendages; (3) in the schizopod character of the feet. These decapods thus degraded approximate to the Entomostracans, although true decapods in type of structure. Thus the principle is exemplified within the limits of a single order as well as in the range of orders. This connection of cephalization with rise of rank is also illustrated abundantly in embryonic development; it is one of the fundamental principles in living nature. When, then, in a group like that of Mammals, in which *two* is the prevailing number of pairs of locomotive organs, there is a transfer of the anterior of these two from the locomotive to the cephalic series, there is evidence in this exalted cephalization of the system of a distinction of the very highest significance. Moreover, it is of the more eminent value that it occurs in a class in which the number of locomotive members is so nearly a constant number. It places man apart from the whole series of Mammals, and does it on the basis of a character which is fundamentally a criterion of grade. This extreme cephalization of the system is, in fact, that material or structural expression of the dominance of mind in the being which meets the desire both of the natural and intellectual philosopher. This cephalization of the human system has been recognized by Carus, but not in connection with a deep-rooted structural law pervading the animal kingdom It is the comprehensiveness of the law which gives the special fact its great weight. Aristotle, in his three groups of mammals—the Dipoda, or two-footed; the Tetrapoda, or four-footed; and the Apoda, or footless species, expresses distinctions according with this law. The term Dipoda, as applied to man, is far better and more philosophical than Bimana. The erect form of the structure in many, although less authoritative in classification, is a concomitant expression of this cephalization. For the body is thus placed directly beneath the brain, or the subordinating power, and no part of the structure is either anterior or posterior to it.

MAN BOTE, in the laws of the Anglo-Saxons, denoted the compensation to be paid for killing a man. In King Ina's laws, certain rates are fixed for the expiation

of this crime, according to the quality of the person slain.

Manchineel, in Bot. (*See* Hippomane.)

Mancipate, *măn'-si-pait* (Lat. *mancipatio*, from *mancipo*, I enslave or bind, *i.e.*, *manu capere*, take with the hand), among the ancient Romans, a species of sale by which the ownership of a person, or of certain things, could be transferred from one to another. It was effected in the presence of not less than five witnesses, who required to be Roman citizens and of the age of puberty, and also of another person, who held a pair of brazen scales. The purchaser, taking hold of the thing, said, "I affirm that this man is my property according to the Quirital law, and he is purchased by me with this piece of money and brazen scales." He then strikes the scales with the piece of money, and gives it to the seller as the price. Gaius calls this a kind of imaginary sale; for though the law required this form in certain cases, yet the real contract of sale was the agreement between the parties. This mode of transfer belonged to all things mancipable (*res mancipi*), for all things, as objects of ownership, were either *res mancipi* or *res nec mancipi*. It appears that the ownership of property generally, belonging to the former class, could only be transferred by these formalities, and included free persons and slaves, animals and lands, whereas those of the latter could be transferred by mere tradition,—the distinction between things *mancipi* and things *nec mancipi*.—Ref. *English Cyclopædia*, Smith's *Dictionary of Greek and Roman Antiquities*.

Mandamus, *măn-dai'-mus* (Lat., we command), in Law, is a writ issuing in the queen's name from the court of Queen's Bench, and directed to any person, corporation, or inferior court of judicature, commanding them to do some particular thing therein specified, which appertains to their office and duty. It is a high prerogative writ of a most extensive remedial character, and issues in all cases where the person applying for it has a legal right to have anything done, and no other specific means of compelling its performance. It may also be issued in some cases where the injured party has another but more tedious mode of redress, as in the case of admission or restitution to an office. It being the peculiar business of the court of Queen's Bench to superintend all inferior tribunals, and to enforce the due exercise of their judicial or ministerial powers, this writ issues to the judges of any inferior court, commanding them to do justice according to the powers of their office, whenever the same is delayed. It also lies to compel the admission or restoration of the party applying to any office or franchise of a public nature, whether spiritual or temporal, to academical degrees, to the use of a meeting-house, &c., also for the production, inspection, or delivery of public books and papers; the surrender of the *regalia* of a corporation; to compel bodies corporate to affix their common seal; to compel the holding of a court, and an infinite variety of other purposes. In order to obtain a mandamus, the applicant lays before the court the affidavit of himself or others, setting forth the facts upon which his claim or title to have the thing done is founded. The court, thereupon, if it see probable cause for interference, grants a rule [illegible] party complained of [illegible] why a writ of [illegible] should not issue, or the court may grant a rule absolute in the first instance. If at the appointed time the party called upon does not appear, or does not show sufficient cause, then the writ itself is issued, as prayed for. At first, it is in an alternative form, requiring the party to do the act or signify some reason to the contrary; to which a return or answer must be made on a certain day. If the person to whom the writ is directed returns or signifies an insufficient reason, then there issues in the second place a peremptory mandamus to do the thing absolutely, without [illegible] him any alternative. Failure to do this is punishable by attachment. Where a sufficient cause is returned, the mandamus is at an end, even although the statement may be false, the remedy for which is by action for false return. However, by 1 Will. IV. c. 21, the prosecutor may now engraft an action upon the mandamus by traversing the matters in the return; and by 6 & 7 Vict. c. 67, he may object to the validity of such return by way of demurrer, and error may be brought for reversing the same, as in ordinary civil actions.

Mandarin, *măn'-dă-rin* (Port. *mandar*, to command), is a term used by Europeans to designate the officers of state in China. They are all men of learning, who have passed certain examinations and had their names inscribed on a register. When an office in the administration is vacant, a list of those that stand foremost on the register is presented to the emperor, who nominates one for the vacant office. The origin of the system of competitive examinations in the bestowment of government offices thus belongs to the Chinese.

Mandate, *man'-dait* (Lat. *mandatum*), in Law, denotes generally a judicial command, charge, or commission. More particularly it denotes a bailment (delivery) of goods to a person who is to do something with or about the things bailed, entirely without compensation. The person delivering the goods is called *mandator*, the person receiving them and undertaking the service is styled *mandatary*. The essential element in the contract lies in the service rendered not being to be paid for. Hence, as the act or service is wholly for the benefit of the mandator, it follows that a mandatary is only responsible for the loss of, or injury done to, a thing when it is caused by his gross negligence. The mandator may recall the thing delivered at any time; but if the mandatary has rendered the service in part, and will suffer damage if it be not completed, the mandator cannot rescind it without indemnity to the mandatary. The contract may also be dissolved either by the renunciation by the mandatary at any time before he has entered upon its execution, or by his death. A mandator contracts to reimburse a mandatary for all expenses and charges reasonably incurred in the execution of the mandate, and also to indemnify him for his liability on all contracts which arise incidentally in the proper discharge of his duty. In the canon law, a mandate is a rescript of the pope, commanding an ordinary collator to put the person therein named in possession of the first vacant benefice in his collation.

Mandats, *man'-da*, is the name given to a species of paper money issued by the French government in March, 1796, to supply the place of the assignats, when they had [illegible] and suffered an enormous depreciation. They were founded, like the assignats, on the credit derived from the confiscated property; but with this essential difference, that specific pieces of property, enumerated in a table, were pledged for the redemption of the bills, whilst the assignats furnished only a general claim. The mandats could be realised at any moment, as the owner was authorized to take any portion of the property enumerated on the table, on paying a quarter part of its assigned value.

Mandibles, *man'-de-bls* (from Lat. *mando*, I chew), the upper and lower parts of the beak in birds. In [illegible], the upper and under pairs of jaws.

Mandolin, *măn'-do-lin*, a Spanish musical instrument of the violin kind, the *cordatura* of which consists of four strings: it has frets like the guitar, and is tuned in the same manner as the violin.

Mandragora, *man-dră-go'-ră* (Lat. *mandragorus*), in Bot., a gen. of the nat. ord. *Atropaceæ*. *M. officinalis* is the true mandrake, the devil's apple of the Arabs, and the dudaim of Scripture. Its root has a fancied resemblance to the human form, and is connected with many absurd superstitions. It must not be confounded with the root of *Bryonia dioica*, which is often called mandrake. The mandrake is an acro-narcotic poison, and was used by the ancients as an anæsthetic.

Mandrake (*See* Mandragora and Bryonia.)

Manes, *mai'-neez*, among the Romans, was the name given to the souls of the dead. The etymology of the word is doubtful, but is generally derived from an ancient word *manus*, signifying good. The manes were divided into two kinds,—the *lares*, or the spirits of those that had lived virtuous lives, and the *larvæ*, the spirits of such as had been wicked. The term manes seems also to have been applied to the good and evil genii, which were understood to accompany a man through life. It was likewise applied to certain of the infernal deities. The superstitious belief that the spirits of the departed continued to take an interest in the affairs of this world, and could exert a powerful influence either for good or evil, made the people very cautious of offending them. Hence libations, and sometimes victims, were offered to the manes, and their remains

were held sacred. The 19th of February was dedicated as an annual festival for offering sacrifices and libations to the manes.

Manganese, *măn-gă-neeze'*, in Chem.,—symbol Mn, equiv. 27·57, spec. grav. 8·013. The ores of manganese are somewhat abundantly distributed throughout the mineral kingdom, generally in the form of black oxide. Manganese is of a greyish-white colour, brittle, hard enough to scratch steel, and slightly magnetic. If exposed to the air, it speedily becomes oxidized, for which reason it should be preserved in some liquid hydrocarbon, such as benzole. Manganese combines with carbon and silica, forming unimportant compounds. Its principal use is chemical, under the form of oxide. It is employed in this state for decomposing hydrochloric acid, in the manufacture of chlorine, as a cheap source of oxygen, and as a colouring material in the manufacture of glass and enamels. Mixed with iron, it gives that metal increased hardness and elasticity; hence its use in the manufacture of steel.

Manganese, Carbonate of, in Chem.—The anhydrous carbonate occurs in nature as manganese spar, and frequently accompanies spathose iron-ore. The famous Siegen ore, from which the celebrated German *spiegel-eisen* is made, contains a certain proportion of this mineral, which renders the iron made from it peculiarly hard and tough. The artificial carbonate may be obtained in a hydrated condition by precipitating the chloride by an alkaline carbonate.

Manganese, Chlorides of, in Chem.—Manganese forms three chlorides. The *protochloride*, MnCl + 4aq, occurs as a waste product in the manufacture of chlorine, by acting on the black oxide with hydrochloric acid. It crystallizes in delicate pink tables, [illegible] deliquescent. The *sesquichloride* is formed by acting on the sesquioxide with hydrochloric acid in the cold. It is of a dark brown colour, and can only be obtained in a solid form by evaporation in vacuo. The *perchloride*, Mn_2Cl_7, is a greenish-yellow gas, which condenses at 0° Fahr. into a greenish-brown fluid. It is obtained by dissolving permanganate of potash in sulphuric acid, and adding chloride of sodium in small portions at a time. It is supposed by [illegible] that this compound is an oxychloride of the metal, corresponding to chloro-chromic acid.

Manganese, Ores of.—The principal ores of manganese are *pyrolusite*, the anhydrous binoxide, and black wad, which is the hydrated binoxide. Both these ores are worked extensively in different parts of the world.

Manganese, Oxides of.—The combinations of manganese and oxygen are principally five in number:—1. The *protoxide*, MnO; 2. the *sesquioxide*, Mn_2O_3; 3. the *binoxide*, *peroxide*, or *deutoxide*, as it is sometimes erroneously called, MnO_2; 4. *manganic acid*, MnO_3; and 5. *permanganic acid*, Mn_2O_7. The *protoxide* may be obtained as an olive-green powder, by igniting carbonate of manganese in a current of hydrogen. It is also procured as a white hydrate by decomposing any salt of manganese with an alkali. It is soluble in ammonia, especially if any ammoniacal salt be present. It unites with acids, forming characteristic salts. The *sesquioxide* is found in nature as *braunite*, and in a hydrated condition as *manganite*. It is obtained as a brown hydrate by passing chlorine through the protocarbonate suspended in water, and afterwards removing the excess of carbonate by nitric acid. Sulphuric acid dissolves it slowly, forming a deep red solution; and hydrochloric acid in the cold also forms with it a soluble compound, both of which are decomposed when the solutions are heated. The *binoxide* or *peroxide* is the most important of the oxides of manganese. It is the black oxide of manganese of commerce, and is found in nature as a *pyrolusite* and *psilomelane*. Black wad is a hydrated form of this oxide. When ignited, it gives off one-third of its oxygen, leaving the red oxide ($MnO\,Mn_2O_3$) behind. It is used in commerce for the production of oxygen, and in the manufacture of chlorine, permanganic acid, and violet glass. *Manganic acid* is not known in an isolated condition. When peroxide of manganese and caustic potash are fused together, and the mass heated with a small portion of water, a green solution is obtained, from which crystals of manganate of potash may be procured by evaporation in vacuo over sulphuric acid. The manganates are very unstable, being decomposed by boiling and even by remaining in dilute solution. The green solution of manganese of potash, when largely diluted, gradually changes to a deep claret colour, and forms the well-known material called *mineral chameleon*. *Permanganic acid* is described under its proper heading.

Manganese, Sulphate of, in Chem., $MnO,SO_3 + 5aq$. This salt is obtained by dissolving the binoxide in sulphuric acid. It forms large transparent crystals of a pinkish hue, varying in shape and composition, according to the temperature at which they are deposited and the number of equivalents of water which they contain. The salt is extensively used in dyeing and calico-printing, and occasionally in medicine. It forms double salts with potash and soda, and an alum with sulphate of alumina, which must not be confounded with the alums formed by the sesquisulphate of manganese with the sulphates of the alkalies. The formulæ of these alums will help to explain this matter:—

$Al_2O_3 3SO_3, MnOSO_3 + 24aq$, manganese-alumina-alum.

$Mn_2O_3 3SO_3, KO,SO_3 + 24aq$, manganese-potash-alum.

It will be seen from this that in one case the protomanganic salt replaces the alkaline sulphate; while, in the other, the aluminous sesquisulphate is replaced by the corresponding sesquisulphate of manganese. The [illegible] sesquioxide is formed by dissolving the sesquioxide in sulphuric acid at a gentle heat. It crystallizes with difficulty, the solution being instantly decomposed by heat.

Manganese, Sulphides of.—Protosulphide of manganese occurs native in black masses in manganese blende. The anhydrous sulphide may be obtained as a dark green powder by treating together a mixture of sulphur and binoxide of manganese. The hydrated salt is obtained as a flesh-coloured precipitate when a solution of a salt of manganese is decomposed by an alkaline sulphide. An oxysulphide of manganese has been formed by passing hydrogen over sulphate of manganese at a red heat. Sulphide of manganese forms [illegible] with the sulphides of potassium and sodium, containing three equivalents of the former to one of the latter.

Mangel-Wurzel, or **Mangold-Würzel**. (*See* Beta.)

Mangifera, *măn-gif'-e-ră* (from *mango*, and Lat. *fero*, I bear), in Bot., a gen. of the nat. ord. *Anacardiaceæ*. *M. indica* produces the mango, a fruit which is highly esteemed in tropical countries. This fruit is a drupe, large, flattened like a lens, and kidney-shaped. When ripe, it is yellow or reddish, with soft and pulpy flesh, filled with juice. Several varieties of the mango-tree are cultivated, which yield fruits differing greatly in size and flavour. Unripe mangoes are used for making the pickle called *chutney*.

Mangle, *mang'-gl* (Ger. *mangel*), a well-known machine for smoothing linen and cotton articles. In its usual form it consists of an oblong rectangular wooden chest, filled with stones, which load it to the degree of pressure which it is required to exert upon two cylinders on which it rests, and which, by rolling backwards and forwards over the linen spread upon a smooth surface beneath, render it smooth and level. It is worked by the hand, the moving wheel being furnished with teeth upon both surfaces of its periphery; and, having a notch cut out at one part, allows a pinion, uniformly driven in the direction, to act alternately upon its outside and inside, so as to cause the reciprocating motion of the chest. There are several varieties of patent mangles; amongst which may be mentioned one in which the linen is rolled round a cylinder revolving in stationary bearings, and pressed downwards by heavy weights hung upon its axes, against a curved bed made to slide backwards and forwards, or alternately from side to side.

Mango. (*See* Mangifera.)

Mango-fish, *mang'-go* (*Polynemus Risua*), a gen. in Ichth., usually termed the *Polynemus*, and belonging to the class *Percidæ* of Cuvier, on account of the ventral fins being inserted farther back than the pectorals. The mango-fish is further distinguished by having several long filaments beneath the pectoral fin, which filaments are, in fact, free rays of that fin. The teeth are

very minute and dense in quantity, and are recurved, like the teeth of a carding-machine. The form of the body generally resembles that of the perch, with the peculiar exceptions mentioned above; the muzzle projects over the mouth; the eyes are large, and placed very forward; and, finally, the dorsal fins are short and widely separated, while the caudal fin is large and more or less forked. The mango-fish is esteemed a great delicacy in India, and it is found principally in Channel Creek, off Saugor, and in and about the mouths of the rivers which intersect the Sunderbunds. The greatest interest is attached to it from the fact of its yielding isinglass; which fact was first discovered by Dr. Cantor, in the year 1838. Dr. Cantor found that a mango-fish weighing two pounds would yield, on the average, sixty-five grains of isinglass, an article which sells in India at the rate of sixteen rupees, or £1. 12s. per pound. Several other varieties of the mango-fish are found in the warm latitudes of Africa and America, and nearly all bear a close resemblance to the type which has just been described.

MANGOSTEEN. (*See* GARCINIA.)

MANGROVE. (*See* RHIZOPHORA and AVICENNIA.)

MANIA. (*See* INSANITY.)

MANICHEANS, or MANI, *män-i-ke'-änz, man'-ni*, is the name of a religious sect founded towards the close of the 3rd century, by one Mani, or Manes. He was a Persian by birth, educated among the Magi, and his system was an attempt to blend Christianity and the religions of ancient Asia. The system is based upon dualism, there being supposed to be two distinct opposing principles from which all things proceed, the former being presided over by a good being,—God; the latter by an evil being,—Hyle. God, the father of light, is described as being all splendour, truth, holiness, goodness, and happiness, and surrounded by twelve æons, or worlds of light, which, as a heavenly zodiac, preside over the great year of the world. These, however, are not emanations from God, but God is one with the kingdom of light, the whole forming one substance. Opposed to the kingdom of light is that of darkness, which is divided into five regions, and in which the prince of darkness sustains the same relation to his inferiors as the god of light occupies in his kingdom. By an inroad made by the powers of darkness into the kingdom of light, the primitive man, the first-born of God, was overthrown and imprisoned. He was subsequently delivered; but a portion of the light remained imprisoned in the darkness. God then brought into existence the present universe, that it might be a receptacle for this lost light; and two new heavenly powers, Christ and the Holy Ghost, proceeded from God to redeem the detained light. The man Adam is then formed by the prince of darkness after the image of the primitive man, comprising, as in a microcosm, the clearest light with the grossest darkness. From him proceeded the human race, each member of which presents a mixture of the two elements light and darkness; and in each succeeding generation the power of the light is weakened by the ascendancy of the darkness. To break this dominion, Christ himself appeared in order to reveal again the lost truth; but his life upon earth, his sufferings and death, were a mere semblance, for the essentially pure light of his being could not unite itself to gross matter. The statements of the New Testament were only partially true; the full truth regarding Christ was first revealed by the Paraclete (Manes). They denied the genuineness of the Gospels, and Acts of the Apostles; the Epistles were regarded as interpolated, while many apocryphal writings, especially the Acts of Thomas, were made use of by them. The work begun by Christ required for its completion Manes, the Paraclete promised by Christ, to lead men to a knowledge of the complete truth, by revealing the secret relations of the universe, and securing the means of human freedom. The redemption of man they held to consist in a knowledge of the revelations made by Christ and Manes, respecting the character of the two empires, the soul and its relation to the body, and a corresponding mode of life. Their system of ethics was thus of a severely ascetic nature, based on the conviction of the intrinsic evil of the body, from the fetters of which their great aim was to set the soul free. For their higher class of members, the *electi* or *perfecti*, a rigorous system of asceticism was prescribed. They were forbidden to eat any kind of food which might increase the power of the body over the spirit; in particular were they to abstain from flesh, which, as the product of Hyle, and as being entirely destitute of light, could only depress the soul. Every kind of work through which man cultivates this world, which is the kingdom of darkness, or makes it a pleasant home, was forbidden. Abstinence from sexual intercourse was regarded as a moral duty, as it was a continuing of the first sin and a preparing of new prisons for the soul. The *auditores*, or lower class of members, were permitted to eat meat, to marry, to occupy themselves with material and industrial pursuits, and to fill public offices; but were also bound to supply the elect with all the necessaries of life. Manes sent out twelve apostles, and these were afterwards represented in the church by twelve magistri, with a thirteenth invisible one, doubtless Manes himself, at their head. After these were seventy-two bishops, who had under them presbyters, deacons, evangelists, and the other electi. They had no temples, and their worship consisted chiefly in hymns and prayers. After the death of Manes, his adherents in Persia were subjected to a long persecution, and many of them are said to have fled to Hindostan. In Syria, Egypt, Palestine, and other countries, they early made their appearance, and the northern coast of Africa became one of their principal seats. Under Constantine they enjoyed toleration, but the succeeding Christian emperors issued severe decrees against them. Nevertheless, they continued to prosper for a long time. Their congregations were numerous, and had many able leaders. In Italy, and especially at Rome, they were very numerous, and maintained intimate relations with the congregations in other countries. Pope Leo I. took severe measures against them, Valentinian III. punished them with exile, and Justinian ordered them all to be put to death. By these persecutions the sect gradually became extinct, although traces of it are found in later centuries in Gaul and Spain, and its influence is to be traced in many of the new sects of the middle ages. Augustine was for nine years a member of this sect, but left them when he found not among them the thoroughness of learning nor the purity of character that he had expected, and he became afterwards their most zealous opponent.—*Ref.* Mosheim's *Ecclesiastical History*, Neander's *Church History;* Dr. C. F. Baur's *Das Manichaische Religions-System nach den Quellen untersucht*, Tubingen, 1831.

MANIFEST, *män'-i-fest* (Lat. *manifestus*, clear, plain, open), in Com., is a paper containing the particulars of a ship and cargo, including the name and tonnage of vessel, the name of the place to which it belongs and name of master; the names of the places where the goods on board have been laden and for which they are destined; a particular account of the packages on board, with their marks, contents, shippers, consignees, &c., as far as may be known to the master. The manifest must be made out, dated, and signed by the master of the vessel at the place or places where the goods, or any part of them, are taken on board.

MANIFESTO, *män-i-fes'-to*, is an apology, or public declaration, in writing, made by a prince, showing his intentions to begin a war, or other enterprise, with the motives that induced him to it, and the reasons on which he founds his right and pretensions.

MANIHOT, *män'-e-hot*, in Bot., the Cassava, a gen. of the nat. ord. *Euphorbiaceæ*. The species *M. utilissima*, the bitter cassava, is an important food-producing plant. Cassava-meal, which is largely employed in the making of the cassava bread or cakes in common use among the inhabitants of tropical America, is obtained by grating the washed roots and then subjecting the pulp to pressure and heat. The roots and expressed juice are virulent poisons, owing chiefly to the presence of hydrocyanic acid; but their poisonous qualities are removed by the washing and heating. Cassava-starch, tapioca-meal or Brazilian arrowroot, and tapioca, are likewise prepared from the roots. The starch is deposited from the expressed juice, and is purified by washing with water. Tapioca is prepared by heating this starch, while moist, on hot plates: it is largely employed in Britain and elsewhere as a dietical substance. The sauce called *casareep* in the West Indies is the juice concentrated by heat and

flavoured with aromatics. The species *M. Aipi*, the sweet cassava, has none of the poisonous properties of the former species. Its root is a common article of food in the West Indies and some parts of South America. It is as mealy as the potato when boiled. Cassava meal, bread, and starch, as well as tapioca, are prepared from the sweet root in small quantities.

Man-of-War, a term generally applied to all vessels belonging to the royal navy, whether ships of the line, frigates, or of any other denomination of vessel. The classes of her Majesty's navy may be thus described from the rules on the subject in the "Navy List."—1. *First Rates*, which comprise all ships carrying 110 guns and upwards, or those in which the complement consists of 1,000 men or more. 2. *Second Rates*, which comprise one of her Majesty's yachts, and all ships carrying under 110 guns, and more than 80 guns; or the complements of which are under 1,000 and not less than 800 men. 3. *Third Rates* comprise her Majesty's other yachts, and all such vessels as may bear the flag or pennant of any admiral-superintendent or captain-superintendent of one of her Majesty's dockyards; and all ships carrying 80 and not less than 60 guns; or the complements of which are under 800 and more than 600 men. 4. *Fourth Rates*, which comprise all frigate-built ships of which the complements are 600 and not less than 410 men. 5. *Fifth Rates*, which comprise all ships the complements of which are 400 and not less than 300 men. 6. *Sixth Rates* are those which comprise all other classes of ships bearing a captain. The remainder of the vessels of the royal navy are enumerated under the title of "sloops," which embraces all vessels commanded by "commanders," and the rest of the vessels commanded by lieutenants; both of which latter classes are not "rated" as the former denominations are. The whole of the above classes and distinctions relate to grades in the vessels of the British Navy as it was constituted before the introduction of armour-plated vessels or ironclads. The introduction of these formidable vessels caused an entire revolution in the classification of our navy. (*See* Navy.)

Man-of-War Bird. (*See* Frigate-Bird.)

Manor, *măn'-or* (Lat. *manerium*, from *maneo*, I remain), in Law, so called from being the usual residence of the owner, seems to have been a piece of territory held by a lord or great personage, who occupied a part of it, as much as was necessary for the use of his own immediate family, and granted or leased the remainder to tenants for stipulated rents or services. The former was called *terra dominicalis*, or demesne land, as being occupied by the lord and his servants; the latter, *terræ tenementales*, or tenemental lands, from being distributed among tenants. The tenemental lands of baronies were anciently distinguished by different names, according to the modes of tenure. *Book-land*, or charter-land, was that which was held by deed under certain rents and free services, and in effect differed nothing from free socage lands. Hence have arisen most of the freehold tenants who hold of particular manors. *Folk-land*, on the other hand, was held by no writing, but distributed among the common people at the pleasure of the lord, and resumed at discretion, being, indeed, land held in the villenage. Manors were formerly called baronies, and every lord or baron was empowered to hold a domestic court, called the court-baron, for redressing misdemeanours and nuisances within the manor, and for settling disputes among the tenants. This court is an inseparable ingredient of every manor, and if the number of suitors should so fail as not to leave sufficient to make a jury or homage, the manor itself is lost. As to the origin of manors, we are told that anciently a certain compass of ground was granted by the king to some man of worth, for him and his heirs to dwell upon and to exercise some jurisdiction, more or less, as he thought good to grant within that circuit, but performing such services and paying such yearly rent as by this grant was required. These superior lords afterwards parcelled out their lands to others, receiving rent and services for them, and were the lords paramount over these smaller manors. These smaller manors came to be subdivided in like manner, to the detriment of the superior lords; till, by the Statute of Westminster 3 (18 Edw. I. c. 1), it was directed that upon all sales or feoffments of land, the feoffee shall hold the same, not of his immediate feoffor, but of the chief lord of the fee of whom the feoffor himself held it. In the present day, a manor signifieth rather the jurisdiction and royalty incorporeal than the land or site; for a man may have a manor in *gross*, *i.e.* the right and interest of a court-baron, and the perquisites thereto belonging, without any part of the land.

Mansard Roof, *măn-sard'*, in Arch., a curb roof formed of four contiguous planes, of which each two have an external inclination, the ridge being the line of concourse of the two middle planes. It is well adapted to a house surmounted by a parapet so high as to cover the lower plane of the roof. It derives its name from that of its inventor, François Mansard, a French architect.

Manse, *mănse* (Lat. *mansa*, or *mansum*), in Law, denotes a house or habitation, either with or without land. In Scotland, the term was originally applied to a portion of ground in a parish set apart for the clergyman; but now it is used to designate his house, the ground to which he is entitled being called his glebe or glebe land.

Mansion, *măn'-she-on* (Lat. *mansio*), in Law, is commonly used to denote the lord's chief dwelling-house within his fee. Among the ancient Romans, *mansio* was a place appointed for the lodging of the princes, or of soldiers in the journey. Mansion-house, ...ses of burglary, &c., is taken for any house or dwe...g of anothe...

Mansion or Villa Residence.—In the accompanying illustrations are given drawings in the Italian style of a mansion or villa residence selected for the practical use of the student. On page 367 are given the "plans" of the structure, showing the arrangement of the rooms. Fig. 1 is the ground-plan, in which *h* is the lobby, *g* the breakfast-room, *f* the drawing, and *e* the dining-room; *c* is the kitchen, and *a* the back ditto; *b* the wash-house; *d* butler's pantry; *j* the closets for hats, &c.; *i* the staircase. The first floor or chamber plan is shown in fig. 2, where *e* and *m* are the principal front bedrooms; *j* being the dressing-closet to the room *m*; *d* and *i* back bedrooms, *g* being a dressing-room to the bedroom *d*; the bath-room is at *h*; *l* is a small bedroom, the servants' bedrooms being at *a* and *b*; *k* is a linen-closet entering from *j*; *c* the watercloset; *f* the sky-light which lights the staircase. In fig. 3 is given the "cellar" or basement plan; *c* stairs beneath those at *c*, fig. 1; *b* the landing, *e* potato-cellar, *a*, *d*, and *f*, cellars for wine, beer, &c. On page 368 are shown in fig. 1 a front elevation, fig. 2 a side, and in fig. 3 a back elevation of the house. On page 369 are given in fig. 1 a section through the line *a b* in the plan, fig. 1, page 367. In fig. 2 an end elevation, and in fig. 3 a plan of the roof.

Manslaughter, *măn-slaw'-ter*, is the unlawful killing of another, without malice, express or implied. (*See* Murder.)

Mansiealing. (*See* Kidnapping.)

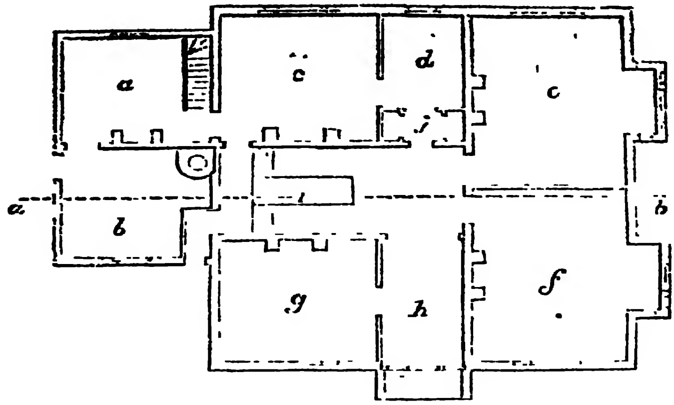
Mantellia, in Geol., fossil cycadeoidea of the Isle of Portland, named in honour of Dr. Mantell.

Man-traps, *măn'-trăps*, are engines to catch trespassers; now unlawful, unless set in a dwelling-house for defence, between sunset and sunrise, by 7 & 8 Geo. IV. c. 18.

Manual, *măn'-u-ăl* (Lat. *manualis*, from *manus*, the hand), is applied to something that may be employed or used by the hand. It is also the name of a service-book used in the Church of Rome, and containing the rites, directions to the priests, and prayers used in the administration of the sacraments, the form of blessing holy water, and the service used in processions. In Literature, it is frequently applied to a class of books of a size to be easily handled, and professing to give a concise account of the subjects of which they treat.

Manucaptio, *măn-u-kăp'-she-o* (Lat., from *manus*, hand, and *capio*, I take), in Law, a writ that lay for a man taken on suspicion of felony, &c., who cannot be admitted to bail by the sheriff or others having power to let to mainprise.

Manuductor, *măn-u-dŭk'-tor*, was an ancient officer of the Church, who gave the signal for the choristers to sing, marked the measure, beat time, and regulated the music, by the motions of his hand.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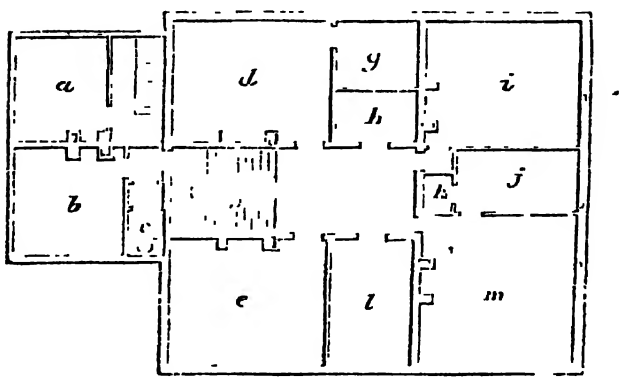
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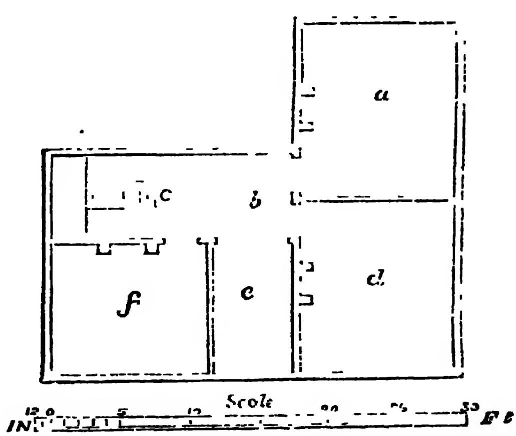
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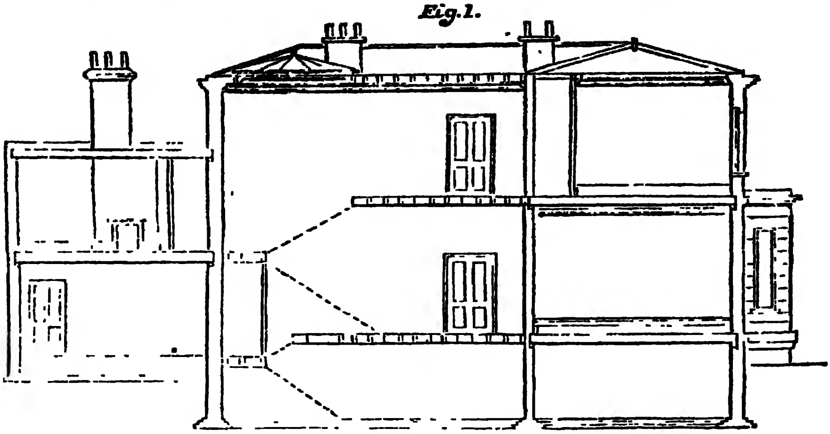
Fig. 1.



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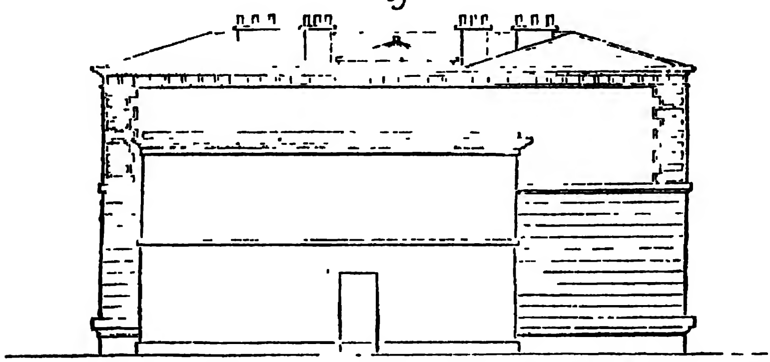


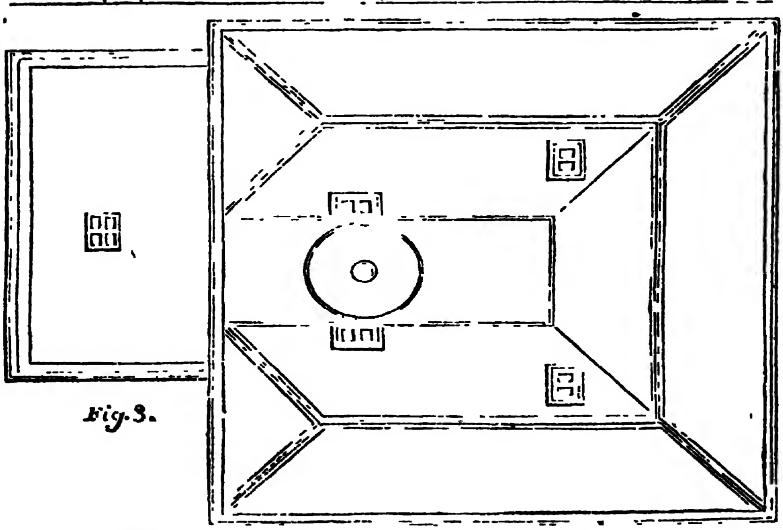


Fig. 3.

Fig. 1.

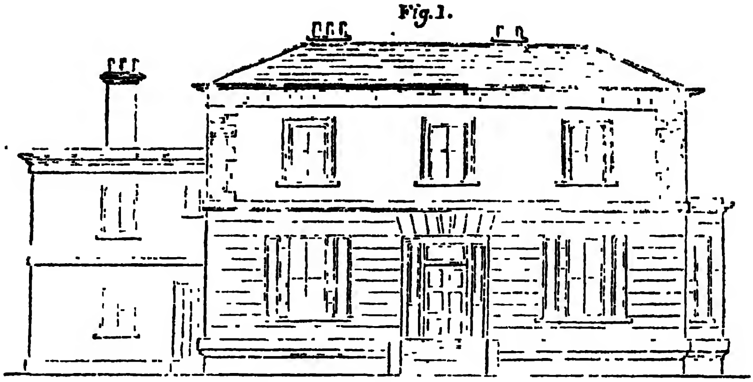


Fig. 2.

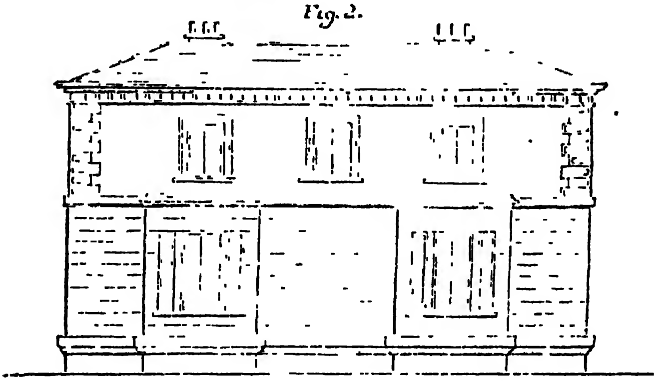
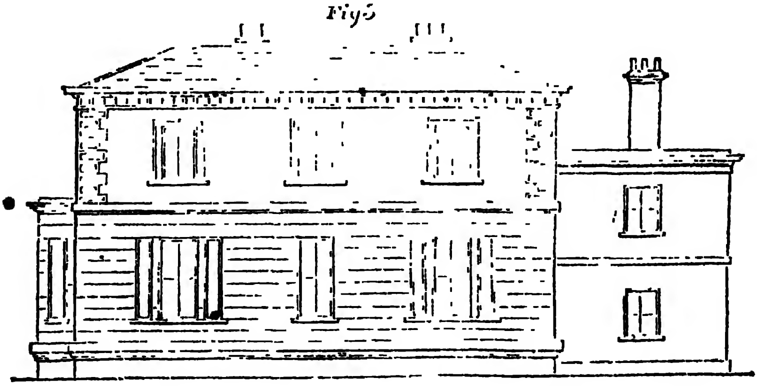
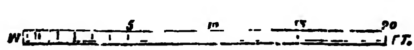


Fig. 3.





Manufacture, *man-u-fak'-tshur* (Lat. *manus*, the hand, and *facio*, I make), may, in its widest sense, be said to comprise the various changes or modifications effected by art and industry in the form or substance of material articles, with the view of rendering them of use to man. It may thus be said to include all the various branches of industry, except such as are employed in obtaining the material products in their natural state; as mining, fishing, &c. The value of any article is made up of the value of the raw material and the value of the labour or skill that has been expended upon it. In some cases the one, and in others the other element predominates. Frequently, even a great deal of labour is expended upon what is termed the raw material; indeed, strictly speaking, the entire value of the raw material is made up of the value of the labour required in obtaining it, and in its conveyance to the place of manufacture. The mere matter of commodities costs nothing. The object of the manufacturer is to produce his articles as cheaply, or at as small an expenditure of labour, as possible; and hence the perfection of a manufacture consists in the being able to effect the desired [illegible] in the raw material at the least possible expen[illegible] labour. In order to secure the greatest amount of profit, the manufacturer must strive to lessen the expense of pr[illegible] Th[illegible] principally effected by the introduction of machinery. "There is," say Babbage, "perhaps no [illegible] which distinguishes our country [illegible] all others, as the vast extent to which we have carried our contrivances of tools and machines for forming all those conveniences of which so large a quantity is consumed by almost every class of the community. The amount of patient thought, of repeated experiment, of happy exertion of genius, by which our manufacture[illegible] been created and carried to their present excellence, is scarcely to be imagined." The [illegible] advantages of machinery result from the addi[illegible] they make to human power, and the economy they effect of hu[illegible] With every contrivance of a new tool, every introduc[illegible]tion of a new machine in manufacture, human lab[illegible] is abridged. In all our larger manufactories, numerous instances occur of the application of the power of steam to overcome resistances which it would require far greater expense to surmount by animal labour. So extensive and important is the economy which machinery produces of human time, that almost all its advantages might be embraced under this one head. Among the other advantages of machinery are the economy of materials employed; the accuracy and identity of the work; the executing operations too delicate for human touch; the increase or diminution of velocity; the accumulating, regulating, and registering powers; and the system of copying, taken in its largest sense, by which a large number of copies are obtained from [illegible] original. Besides the introduction of machinery, there are certain economic principles which, by being carried out in manufacture, tend to diminish the expense of labour. One of the most important of these is a proper division of labour among the persons employed. A great waste of time and labour is necessarily incurred when one has to carry on successively several operations. There is always some time lost in the changing from one operation to another; and neither the human hand nor head can instantly change its employment with full effect. There is also a large degree of skill acquired by frequent repetition of the same processes. (*See* Division of Labour.) There is a further important principle in division of labour, viz., that the master can thus purchase the precise amount of skill or power necessary for each process; whereas, if the whole work were executed by one workman, he must possess skill to perform the most difficult as well as strength to execute the most laborious. But it may readily be supposed that this division of labour can only with advantage be carried to a certain point. In order to conduct an establishment most profitably, it is evident that the whole time of each person ought to be fully occupied. If it be found that a certain number of individuals are necessary to carry out a manufacture with a due subdivision of labour, so as to afford full occupation to each, then every such manufactory ought to employ a direct multiple of this number, in order to produce their articles at the least cost. If, for instance, in the manufacture of pins, ten be found to be the number of individuals by which it can be most advantageously carried on, then it is evident that the manufacturer who can only employ five persons must, upon the principle of subdivision of labour, produce his articles at a greater cost; and in the same way, any large manufacturer who employs a number not a multiple of ten must do so likewise. A good deal depends, too, upon the size of manufacturing establishments. Where the article in the course of manufacture has to be conveyed from one operator to another, it is evident that this can be done at least expense when they are all working in the same establishment. The circumstances that more particularly tend to the success of manufacturing industry in a country are various, but may be divided into two classes,—physical and political. Among the more prominent of the physical circumstances that tend in that direction, one of the principal is readiness of access to supplies of the raw material to be manufactured. Where the raw material has to be brought from a distance, its cost, especially if it be of a bulky or [illegible] nature, will be very much increased, and con[illegible], also, the cost of the manufactured article, which, unless favoured by other circumstances, cannot be produced so cheaply as in those places that are more favourably situated in that respect. In the early history of a manufacturing community, where the means of transport are few, it will be almost always found that the article will be manufactured near those spots where nature has placed the raw material. Even [illegible] important than the possession of the raw material is the command of power which a country may afford for the carrying on the manufacture; as water-power, fuel, &c. To our valuable mines of coal [illegible]re than anything else is this country indebted for her enormous manufacturing industry. Without a cheap and abundant supply of fuel, our steam-engines would be of comparatively little use. The climate of a [illegible]try has also an important influence over manufacturing industry, as well as the situation of a country for commerce, and the possession of rivers that may serve as means of conveyance. Among the circumstances of a political nature that contribute to the progress of manufacturing industry, are security to property and freedom to carry on the various operations of their manufacture; the absence of monopolies and the non-interference of government in industrious undertakings. Some are disposed to maintain that the taxation to which we are subjected in this country has been favourable to the progress of industry, by causing a man to put forth all his energies to prevent himself from sinking in the social scale. There can be little doubt that the great inequality of fortune that has prevailed in this country has had a material influence [illegible] of invention and industry among the less opulent classes.—Ref. *Encyclopædia Britannica*; *Encyclopædia Metropolitana*; being a Treatise on the Manufactures and Machinery of Great Britain, by P. Barlow, with Introduction by C. Babbage; Ure's *Philosophy of Manufactures*, by Simmonds.

Manufacture of Carpets.—Carpets were first brought into use by the inhabitants of Eastern countries, who threw them on the ground or floor, or over the low couch on which they were in the habit of sitting or sleeping. The small thick woollen carpet of the East was also materially calculated to add to the personal comfort of those who dwelt in tents, as it afforded warmth and protection from any dampness arising from the earth over which their tents were pitched. In Egypt, Syria, Turkey, and Persia, the carpet is the chief article of furniture to be found in ordinary houses, the peculiar habits of the people requiring but little more in addition. The use of carpets in this country dates from the middle of the 12th century, but their manufacture was not carried on to any extent until the middle of the 18th century, nearly 200 years after it had been introduced into France from Persia. In olden times, even the floors of the rich and powerful were covered with straw or rushes, and presented anything but a desirable appearance, from the dirty habits for which our forefathers in all classes of society were, unhappily, notorious. The Turkey carpets are made in one piece, and generally consist of a dark central ground, figured with a small irregular angular pattern,

in various rich colours, surrounded by a border. There is little or no attempt made to produce the regular and symmetrical patterns that are seen in carpets of European manufacture. A genuine Turkey carpet should be free from any admixture of green, which is the sacred colour of the followers of Mahomet. The warp is made of very strong linen or cotton thread, and the coloured worsted is tied to it in tufts, which are afterwards cut, to bring them to the same level. As the terms *warp*, *weft*, *chain*, *shoot*, will be often used in this article, it will be necessary to mention, that the warp or chain consists of the strings of cotton, linen, or hemp, that extend longitudinally from end to end of the length of carpet, and the weft or shoot is the line or lines that are introduced transversely, from side to side of the piece, between the threads of the warp, as the alternate threads of this component part of the carpet are raised and depressed by turns by the action of machinery. The principal kinds of carpets made in this country are the Brussels, Wilton, Kidderminster, Tapestry, Axminster, Dutch, Venetian, and Printed Felt carpet. Brussels carpets consist of an upper surface of worsted yarn attached to a strong coarse linen web; lines of worsted are arranged with those of the warp, proceeding in the same direction from end to end of the length of the piece. As many threads of worsted are put in each of these lines, or "ends," as they are generally called, as there are colours in the piece. Two wefts, or shoots, are used, one passing above and the other under the woollen yarns, by which they are bound tightly together, and give substance and solidity to the whole fabric. The pattern is made by drawing loops of these yarns above the surface of the linen basis, between each passage of the shoots from side to side. The means by which this arrangement is effected are rather complicated, and require to be seen to be thoroughly understood Each coloured yarn that aids in forming the pattern passes through a small metal loop, called a "mail;" cords are attached to these mails, which pass over pulleys arranged in a frame above the loom, and fastened to a roller near the floor; strings, called "lashes," are attached to the cords that are fastened to the mails, every lash being passed round all the cords attached to the yarns that it is necessary to raise above the surface in each transverse ridge of the pattern; and there are as many lashes as there are ridges or stripes necessary to complete the entire pattern from beginning to end. The longer the space the pattern occupies, the greater will be the number of lashes required; thus, in a pattern which occurs once in every yard of the length, there will be three times as many lashes required as there will for a pattern which occurs three times in every yard. When the process of weaving carpets is in progress, each successive ridge is formed in this manner — The lash which holds the cords attached to the yarns which must then be brought above the surface of the linen basis, is pulled towards him by the weaver. this raises the required yarns to a considerable extent, and the weaver is enabled to thrust a long thin piece of wood, called a "sword," about four or five inches wide, under the loops that have been thus raised; a thin wire is then introduced, and the sword is withdrawn The loops are next drawn tightly over the wire, half of the linen threads of the chain are raised, and the other half and the woollen yarns are lowered. The upper weft is then shot through by means of the shuttle, the position of the alternate threads of the chain and the yarns reversed, and the under weft is shot through. The whole is then pressed tightly together with an instrument called the "batton;" when this has been done, the yarns required to form the next ridge are brought above the surface, and the process already described is repeated until the piece is completed. When a sufficient quantity of carpet has been made, the wires are pulled out. In the Wilton carpets, the loops thus formed over the wires are cut, and form a velvet-pile surface; each wire is grooved, and a sharp knife, the point of which works in the groove, is drawn through the worsted, and the wire is freed thus, instead of being pulled out. Kidderminster carpets, sometimes called Scotch carpets, present the same pattern on both sides, with the colours reversed; thus, if red stars are shown on a white ground on one side, the other side will present white stars on a red ground. These carpets consist, for the most part, of the interweaving of two cloths, which are woven at the same time, each cloth being perfect in itself, and necessarily of different colour. Kidderminster carpets, consisting of three, and even four cloths, called three-ply and four-ply carpets, have been made; but those which consist of two cloths only are the most common. Many colours can be introduced into Kidderminster carpets by using different coloured wefts; but this gives a striped appearance to the surface, which deteriorates from its appearance. In manufacturing this sort of carpets, two chains of different colours are used, and two shoots corresponding in colour with the chains. The process of weaving is complicated, and it was formerly effected by means of intricate and cumbersome machinery. This, however, was simplified by the introduction of the barrel-loom, which has, in its turn, been superseded by the Jacquard loom (*see* JACQUARD LOOM, and WEAVING), which is used in the manufacture of Brussels and Wilton carpets, as well as in making Kidderminster carpets. Tapestry carpets are made . a manner similar to Brussels and Wilton carpets, but only one yarn is used instead of five or more of different colours, as in the carpets just named. This yarn is dyed at different parts of its length, to suit the requirements of the pattern, and as the whole pattern is printed on the yarns, the machinery required is of a far less complicated nature than when it is required to pull many yarns of different colours above the surface of the cloth which forms the basis in order to produce the desired design. Axminster carpets are made at Axminster, in Devonshire, in a manner similar to that which Turkey carpets are manufactured. Tufts of orsted are tied to a warp of strong linen and secured by a linen weft. The process is tedious, and the carpets are necessarily expensive: they are made in one piece, to suit the size of the rooms for which they are required Dutch and Venetian carpets are made in ordinary looms. The patterns adopted are usually stripes or large plaids. The chain consists of stripes of worsted yarns of different colours, and the shoot is generally a thick black cord of wool or cotton, or these materials combined. When a transverse stripe of a different colour is required to give the appearance of plaid, a different shoot must be used. The Dutch carpets are a coarse variety of the Venetian, the chain consisting of dyed hemp, on which account they are sometimes called string carpets. The printed felt carpets are made of coarse wool and hair, brought into a compact mass by the process of felting (*see* FELTING), and the pattern is imprinted in colours by means of rollers on which it is cut. Of the carpets that have been mentioned, the felt carpets are the cheapest; they are also serviceable and comfortable, being warm, and quite impervious to draughts. Brussels carpets are the most expensive; but this is, in a great measure, compensated by their durability. Tapestry carpets are cheaper, but the colours are not so lasting as those of the Brussels carpets. Dutch and Venetian carpets are sometimes laid down in sitting-rooms, but they are more generally used for covering staircases: they are cheap, but far from durable.

MANUMISSION, *măn-u-mish'-un* (Lat. *manus* and *mitto*), in Rom. Antiq., was the form by which slaves were released from their condition; so called because they were sent, as it were, out of the hand or power of their master. There were three ways in which slaves were manumitted,—by *vindicta*, census, or will. The first of these was the most ancient, and in it the slave was brought before the magistrate, who laid his wand, *vindicta*, upon his head, and declared him to be free. The manumission by census was effected by the name of the slave, with his master's consent, being inserted in the census or public register of the citizens. By will, a slave could be made free conditionally or unconditionally, or free and an heir of the testator. By manumission the relationship of patron and freedman was established between the parties There have been various forms of manumission in England In the time William I., villeins were manumitted by the master delivering them by the right hand to the viscount in full court, showing them the door, giving them a lance and a sword, and proclaiming them free. Others were manumitted by charter. There was also an implied manumission, as when the lord made an obligation for

payment of money to the bondman at a certain day, or sued him where he might enter without suit, &c.

MANURE-DISTRIBUTOR, *măn-ūre'*, an agricultural implement, used for distributing manure easily and at regular distances. It is usually combined with the ordinary corn-drill, so that the corn and the manure are delivered together. The machine is generally so arranged that the manure can, at the pleasure of the cultivator, be deposited, not only from two to three inches deeper in the ground than the seed, but from ten to twelve in advance of it, so as to give the soil time to cover the manure before the next coulters deposit the seed. The progress of the manure-drill has been very slow, although the advantages arising from its use are many and palpable. By placing the seed in direct contact with manure in the process of germination, it is well nourished at that period in its growth when it most needs assistance, in order to develop its fibres and to extend its roots.

MANURES, *man-ūrez'* (Fr. *manœuvrer*, from *main*, the hand, and *ouvrer*, to work), a term applied in Agr. to vegetable, animal, or [illegible] matters introduced into the soil, either for the purpose of improving its texture or for directly nourishing the plants which grow in it. Thus, if the soil be too stiff with clay, sand is used; if, on the contrary, it be too loose with excess of sand, it will be benefitted by the addition of clay. *Marl*, a natural mixture of clay and lime, sometimes containing a little silica and bitumen, is very useful as a manure in the improvement of soils. Its great advantage is, that it dilates, cracks, and is reduced to powder by exposure to moisture and the atmosphere; and it operates by subdividing the soil and hastening decomposition. *Quick-lime*, especially that derived from fossil or living shells, is a very excellent manure. In cold marshy soils, abounding in organic mat[illegible] it is particularly efficacious in converting animal and vegetable matters into nourishment for plants. In consequence of the alkali which *ashes* contain, they attract moisture from the atmosphere, and thus accelerate vegetation. The most universal mineral manure known is gypsum, or sulphate of lime; but chemists are not agreed as to the way in which it acts upon vegetation. Ordinary manure consists of organized bodies, either animal or vegetable, in a state of decomposition. Decomposing animal matter of every description forms one of the most active manures, and in many cases accelerates the decomposition of inert vegetable matters mixed with it; as in the mixture of dung and straw, which forms the ordinary refuse of the stable. Those bodies which are subject to the most rapid decomposition are most generally employed as manure. All animal excrements are powerful manures, and when properly applied to the soil, soon show their action by the improved appearance of the crops. Esculent vegetables, however, soon acquire a coarse and rank flavour if they are over-manured. In [illegible] of animal manures, it is very important that they should be applied as soon as they begin to decompose, or as soon as possible afterwards, and not suffered to rot and exhale their best constituent parts whilst lying in the farm-yard. The drainings and evaporation of a dungheap contain its most valuable component parts. Animal manures which decompose slowly generally operate most effectually. Of those the best is ground bones, the effects of which are long-continued: the [illegible] matter contained in bones is frequently beneficial to many crops. Amongst excrementitious solid substances, one of the most powerful is the dung of birds which feed on animal food, especially the dung of sea-birds. Guano is a manure of this kind. (*See* GUANO.) Vegetable manures are often effective, especially in the case of ploughing in a green crop. *Rape-cake*, when used recent and kept dry, forms an excellent dressing for turnip crops. Sea-weeds, consisting of various species of *fuci*, *algæ*, and *confervæ*, are considerably used as manure in many parts near the coast. The effect of sea-weed manure is transient, and does not last for more than a single crop. *Soot* is also a powerful manure; it requires no preparation, but is thrown into the ground with the seed. The most ordinary manure used consists of a mixture of animal, vegetable, and mineral substances. It is better to manure land in the spring than in the autumn, lest the winter rains should dissolve it too much, and endanger its sinking below the roots of the crop. As the stock of manure is generally limited, it is the study of agriculturists to discover some means of compensation for a deficiency. In a judiciously arranged rotation of crops, this compensation is obtained. (*See* SUPERPHOSPHATE OF LIME.)

MANUSCRIPT. (*See* PALÆOGRAPHY.)

MANUSCRIPT, ALEXANDRIAN. (*See* ALEXANDRIAN MANUSCRIPT.)

MAP, *măp* (Lat. *mappa*, a towel, or cloth; maps may have been originally drawn upon cloth), a delineation of the surface of the earth, or any part of it, exhibiting the lines of latitude and the relative positions of countries, mountains, seas, rivers, &c. For the construction of maps different mathematical hypotheses have been adopted. *Projection* is one method of construction, in which the boundaries of countries and their more remarkable features are represented according to the rules of perspective, on the supposition of the eye being placed on some point of the sphere, or at some given distance from it, which may be increased indefinitely. This method answers very well when the surface to be represented is of small extent and the point of view nearly over the centre; but when the surface is of great extent, places near the border of the *projection* are much distorted. *Development*-maps are constructed on the supposition that the spherical surface of the earth to be represented is a part of a cone, the vertex of which is situated somewhere in the polar axis produced, and the conical surface is supposed either to touch the sphere in the middle parallel of the map, or to fall within the sphere at the middle parallel, and without it at the extreme parallels. The surface of the cone is then supposed to be spread out into a plane. Another method of constructing maps depends upon the development of a cylindrical surface, by which means they have the parallels of latitude and circles of longitude respectively represented by parallel straight lines. Terrestrial maps of this description are usually called *Mercator's Charts*, although the invention is due to an English mathematician, Edward Wright. *Celestial maps* are representations of the positions of the stars on a plane surface, constructed on similar principles.

MAP, DELINEATION OF.—The method of delineating the various features of a country or district in a map as shown in fig. 1, where A represents a piece of inland water or lake; E E a river proceeding from this; B the garden attached to the mansion; C a hill, with trees on its summit; O O, near the river E E, represents rising ground on its margin; H H plantations of trees; O O a swamp or morass; K K meadow-lands; L L a public highway. In the following illustrations the features are shown on a larger scale, as in fig. 2, which represents a hilly or mountainous ridge. Fig. 3, rising ground near a river. Fig. 4, the same. Fig. 5 represents a river, with small stream issuing from it and traversing a meadow. In copying this, the pupil should fill up the whole of the part representing the extent of meadow (within the boundary-line), as in the corner of the illustration now given. Fig. 6 represents swampy ground with trees. Fig. 7 represents a river entering the sea; the coast is delineated as in the sketch. Fig. 8 represents part of a sea-line of coast *c c*, with sandy shoal *b b*, and swampy morass *a a*. Fig. 9 represents the method of delineating a rock, used in marine maps. A range of rocks is represented in fig. 10, and a rock surrounded by sand in fig. 11. Fig. 12 represents a sandy shoal. The method of delineating water in a basin or harbour is shown in fig. 13. The manner of representing blocks of houses in a town or suburban district map is represented in fig. 14. This example is also designed to show the use of squares in reducing or enlarging maps. Fig. 15 is the same subject as in the previous figure. The pupil, aided by the letters of reference and the figures, should have no difficulty in finding the various points in fig. 15 from fig. 14, and *vice versâ*, if the plan is fig. 15 to be enlarged twice, as in fig. 14. Irregular portions of maps may be copied by adopting offset lines, as in fig. 16, which represents part of a river, which is required to be copied and enlarged as below. Draw any line *c d*, from any scale set off distances, as $c\,g = 50$ $g\,h = 20$, and so on. Next draw a line, as *p o*, corresponding to *c d*; from *p* set off distances corresponding to those in *c d*, but taken from a scale larger than that of *c d*.

From the ____ scale as that from which the measurements on *c d* were taken, measure the lines drawn at the various points at right angles to *c d* to where they touch the outline of the lowest side of river, as *g* = 40. Make the line *t* the same distance, but taken from its proper scale; by proceeding thus, points will be found, by tracing through which an outline will be obtained

equal to that of the copy. The angle *d c b* is equal to 40°. The pupil should extend this principle of copying irregular figures, by which he will be enabled to judge of its utility in practice. In figs. 17, 18, 19 and 20, we give a few examples of the lettering attached to maps and plans Fig. 21 shows the compass-mark in plans, by which the directions are obtained. Th.

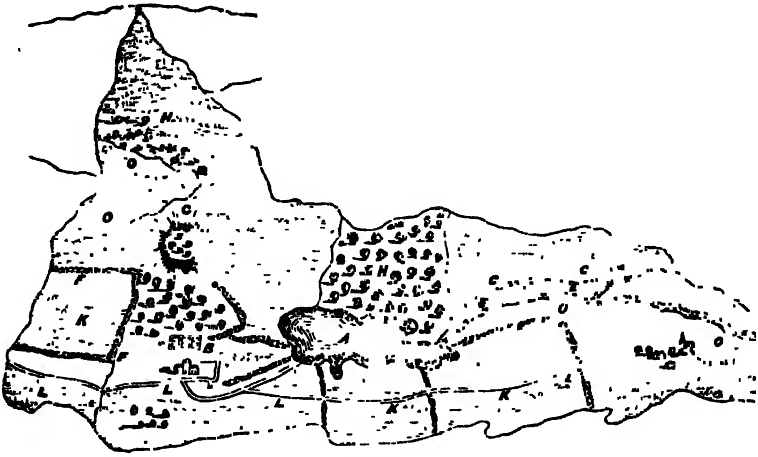


Fig. 1.

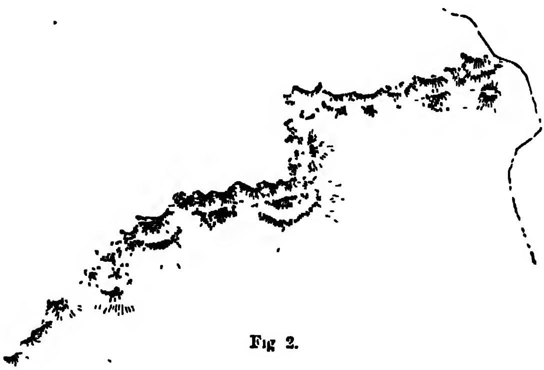


Fig 2.

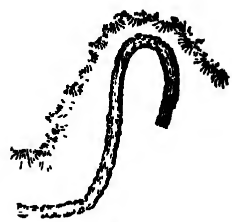


Fig. 3.

Fig. 4.

Fig. 5.

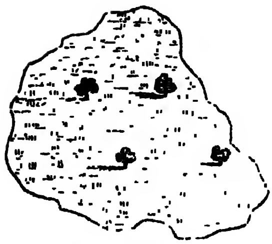


Fig. 6.

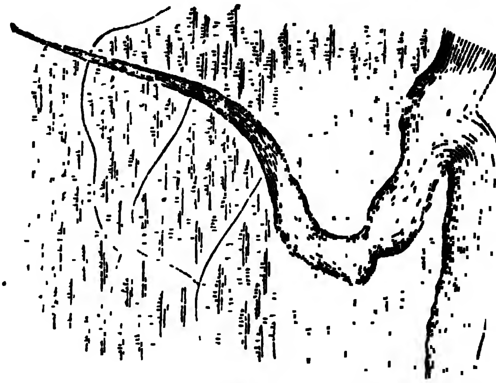


Fig. 7.

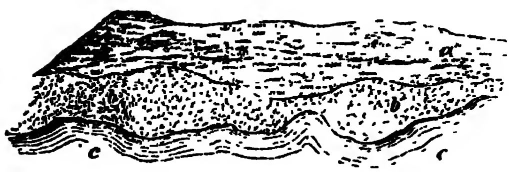


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

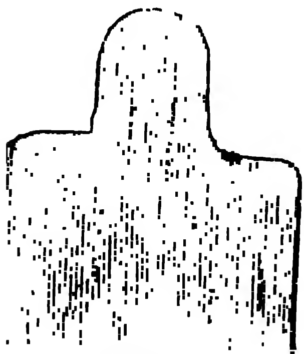


Fig. 13.

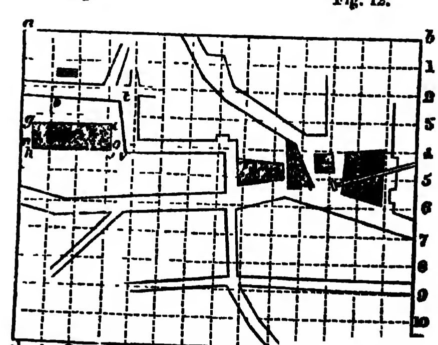


Fig. 15.

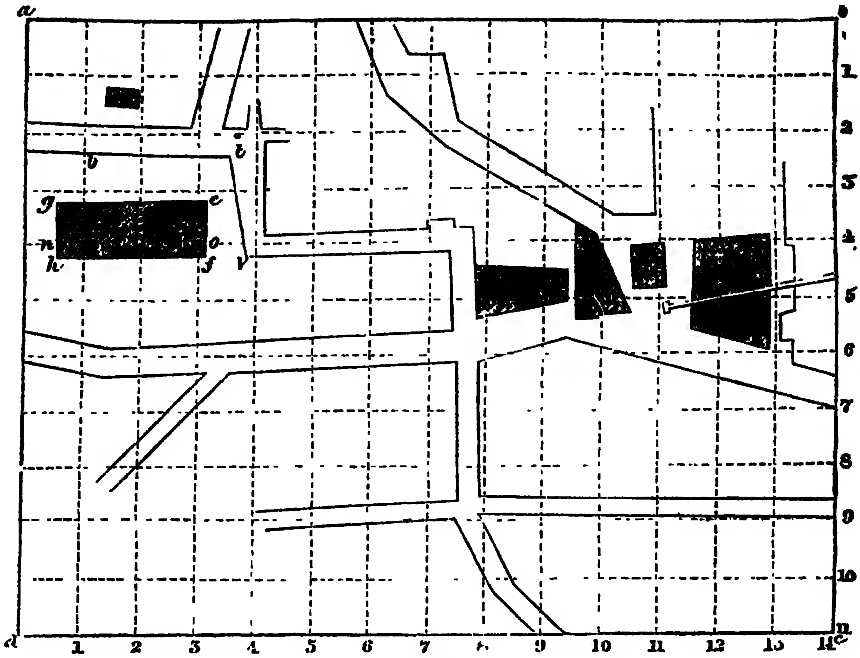


Fig. 14

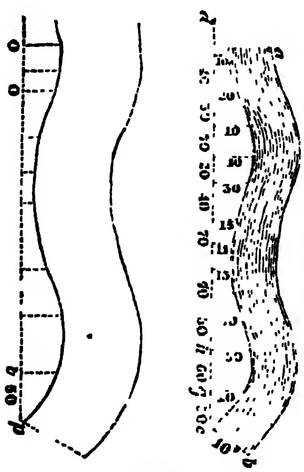


Fig. 16.

Fig. 17.

Fig. 18.

REFERENCES.

GREEN............

RED..................

Fig. 19.

PARISH OF

Fig. 20.

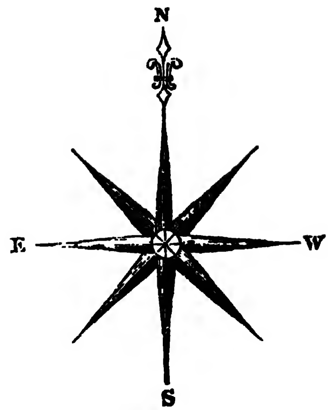


Fig. 21.

Fig. 22.

fleur-de-lis always points to the north. Fig 22 represents the plan of part of a district through which a road *a b* is to be cut.

MAPLE. (*See* ACER.)

MARABOU, *mär'-ă-bu* (*marabou*, the native African name), the popular name of several large birds belonging to the Stork family, included in the genus *Leptoptilus* of Lesson. The birds are natives of Africa and Asia. The Asiatic variety of marabou, called the Adjutant, has no equal in size except the ostrich. The feathers of this bird command a high price as articles of personal adornment. They are principally used for ladies' head-dresses, and are as light as they are graceful. A smaller species, the *Leptoptilus Marabou* of Temminck, occurs in tropical Africa, assisting the vultures in consuming the filth of the Negro villages. Its appearance is even less prepossessing than that of the Asiatic bird, though its plumes are equally valued.

MARABOUT, *mär'-ă-boo* (Arab. *marbouth*, or *morabeth*, saint or hermit), is a name given to a class of religious devotees among the Mohammedans of the Barbary states. They frequently affect to work miracles, and some of them are held in high estimation; but most of them are little better than vagabonds. The dignity of a Marabout is generally hereditary, the Great Marabout taking rank immediately after the monarch. The most distinguished Marabout of our own time is Abd-el-Kader.

MARANTA, *mă-răn'-tă* (after Maranti, a Venetian physician and botanist), in Bot., the typical gen. of the nat. ord. *Marantaceæ*. The species *M. arundinacea* yields West-India arrowroot, one of the most pure and best-known of the amylaceous substances used as food. This is extracted from the rhizomes and tubers of the plant; it forms a very firm jelly, and is the most palatable and digestible starch known. The name arrowroot was originally applied to the rhizome of this plant from the fact of its being employed by the native Indians to form a sort of poultice for wounds inflicted by poisoned arrows. The name arrowroot has since been given to other starches used as food in this country. The species *M. ramosissima* also yields arrowroot, and is largely cultivated in the East Indies.

MARANTACEÆ, *mär-ăn-tai'-se-e*, in Bot., the *Maranta* or Arrowroot fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*, consisting of herbaceous plants having a close resemblance to *Zingiberaceæ*. Their distinctive characters are, in their more irregular perianth; in one of the lateral stamens being fertile and the other two abortive; in the fertile stamen having a petaloid filament, and an entire or 2-lobed anther with one lobe sterile; in the style being petaloid or swollen; and in the embryo not being inclosed in a vitellus. There are seven genera and 160 species, all natives of tropical regions. The rhizomes of some species contain starch, which, when extracted, is extensively used as food. (*See* CANNA and MARANTA.)

MARASCHINO, *mar-a-ske'-no* (Ital., from *marasca*, a kind of sour cherry), a liqueur composed of the kernels of cherries bruised and infused in spirits of wine. The infusion is distilled, and to the product are added oil of neroli and distilled water. A large quantity of this liqueur is made in France; but that which comes from Switzerland is considered the best. It is considered a good stomachic; but as it contains much of the principle of prussic acid, it is a dangerous liquid to indulge in.

MARASMUS, *mă-răs'-mus* (Gr., emaciation), in Med. is a term often used by older writers to denote a wasting of the body for which no cause could be discovered.

MARBLE, *mar'-bl* (Fr. *marbre*), a term applied by mineralogists to limestones, white or coloured, capable of receiving a polish. In the ordinary parlance of the mason, it means almost any rock which may be polished; such as steatite, serpentine, breccia, &c. The use of marble for ornamental and artistic purposes dates from the remotest antiquity. Italy is the principal ...

The principal quarries of the district are at Carrara, Massa, and Seravezza, and produce between forty and fifty thousand tons per annum of white and coloured marbles. La Spezzia, Monti, Pisani, Campiglia, Elba, Sienna, and Gerfaleo, also produce marble of great excellence and beauty, but in comparatively small quantities. The principal Italian marbles are *Carrara* (often miscalled Sicilian), pure white; *Giallo antico*, yellow, more or less veined; *Rosso antico*, blood-red, and speckled with white; *Portoro*, black, with gold rings and veins; *Bardiglio*, dove-coloured and veined; *Lamachello*, dark brown, with iridescent particles; *Cipolin*, white, with green rings and veins; *Mandeluto*, red, with yellow spots; *Brocatello di Siena*, yellow, with purple spots; and *Verde antico*, clouded green. Parian marble occurs in the island of Paros, and is almost as celebrated as that from Carrara. The former has a more wavy look than the latter; for which reason it is preferred by many sculptors for nude statues. The principal marbles found in Great Britain are the Kilkenny and Connemara, black and green marbles; Bristol, Sussex, and Derbyshire marbles, containing shells; the encrinital marbles of Derbyshire; the Cornwall, serpentine, and steatite.

MARBLES, ARUNDELIAN. (*See* ARUNDELIAN MARBLES.)

MARBLES, ELGIN. (*See* ELGIN MARBLES.)

MARCGRAVIACEÆ, *mark'-grai-ve-ai'-se-e*, in Bot., the *Marcgravia* fam., a small nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*, generally regarded as ... allied to *Clusiaceæ* and *Hypericaceæ*. The sp... belonging to it are, however, distinguished from *Clusiaceæ* by their alternate leaves, unsymmetrical flowers, versatile anthers, and very numerous minute seeds. They are distinguished, on the other hand, from *Hypericaceæ* by their equal-sided petals, distinct stamens, and sessile stigmas. There are four genera and 2... species, generally natives of equinoctial America. Little is known of their properties. *Marcgravia umbellata* is said to be diuretic and antisyphilitic. Curious pitcher-like bracts occur in some of the genera.

MARCH, *martsh* (Lat. *Martius*, Mars), is the name of the third month of our year, ... thirty-one days. It was so named ... by Romulus, in honour of his ... the first month of the Roman year; and, indeed, till the alteration of the style in 1752, the legal year in England commenced on the 25th of March. The Anglo-Saxons commonly called this month *Hlyd monath*, the loud or stormy month; and the last three days of it are still known in some parts as the borrowing days (which *see*).

MARCH, a military air in duple time, played by pulsatile and inflatile instruments, to regulate the steps and enliven the spirits of soldiers. A march ought always to be written in common time, beginning with a broken bar with an odd crotchet or quaver. On parade occasions, it is played in slow, but for ordinary marching in quick time. Although properly belonging to martial music, the march has long since obtained admission into all kinds of music, and is adapted to every kind of instrument. Thus, we find it in the compositions of the greatest masters; as, for instance, the march in "Guillaume Tell," the religious march in Mozart's "Zauberflote," and in Gluck's "Alceste," the wedding march of Mendelssohn, and the "Dead March" in Handel's oratorio of "Saul."

MARCHANTIA, *martsh-an'-te-ă* (after M. Marchant, a French botanist), in Bot., a gen. of liverworts. *M. hemispherica*, and other species, have been employed in the form of poultices in dropsy.

MARCHES, *martsh'-ez* (Ang.-Sax.), denotes the country lying near or about the *marks* which indicated the limits of two kingdoms, &c. In England, the march lands were those lying adjacent to the borders of Scotland and Wales. (*See* BORDER, THE.)

MARE, the female of the horse. (*See* EQUIDÆ and HORSE.)

MARGARIC ACID, *mar-găr'-ik* (from Gr. *margaron*, a pearl), a fatty acid, supposed at one time to be distinct, but ascertained by Heintz to be a mixture of one part of stearic acid and nine or ten of palmitic acid. It is a singular fact, that although the melting-point of stearic acid is 159° Fahr., and that of palmitic acid 143·6° Fahr., yet the mixture of the two melts at 140° Fahr.

MARGARIN, *mar'-gă-rin*, a neutral fat, at one time supposed to be distinct, but now ascertained to be a mixture of stearine and palmitin. It is called margarin from *margaron*, Gr., a pearl, on account of its crystallizing in pearly scales.

MARGRAVE, *mar'-graiv* (Ger. *markgraf*, count of the Mark), a title originally bestowed on a commander intrusted with the protection of a *mark*, or country on the frontier. Marks and margraves begin to appear in history as early as the reign of Charlemagne. In rank, margraves stood next to the kings and emperors, and above the dukes in whose country the margraviate was established. In some cases, however, some margraves were dependent upon the dukes. In the 12th century margraviates became hereditary, and the rank of margrave was equal to that of a prince of the empire, standing between counts and dukes in the German empire.

MARIA THERESA, ORDER OF, *mă-ri'-ă te-re'-să*, is the name of an Austrian military order, founded in 1757, and having grand crosses, commanders, and knights.

MARIGOLD. (*See* CALENDULA.)

MARINE INSURANCE. (*See* INSURANCE.)

MARINES, *ma-reenz'* (Lat. *marinus*, pertaining to the sea), a band of soldiers enrolled and disciplined to serve on board ships in a naval engagement, or on ... here they might co-operate with a fleet in attacking an enemy's coast. There is no positive information as to what time distinct corps of troops ... appointed in the naval service of Great Britain. There is some mention in 1684 of the Duke of York's ... regiment of foot-soldiers. In the reign of William III., several regiments were enrolled for the service of the navy; but they appear to have been considered more as embryo seamen than anything else, for as soon as they were duly qualified, they were struck off the muster-roll and entered for seamen, as foremast men. ... the reign of Queen Anne six regiments of marines ... sed, and these may be said to have formed the nucleus of the present force. In the year 1755, on the recommendation of Lord Anson, the marine force was altogether reconstructed, and raised to 130 companies, ... sisting of about 5,000 men. In the year 1759 ... force numbered about 18,000 men, and during the war at the end of the last century and beginning of the present one, the marines mustered some 20,000 men. In the present day the marines are divided into two branches,—the *Marine Artillery* and the *Marine Light Infantry*; the former being composed of 17 companies and the latter of 116. The total strength may be estimated at 100 staff officers, 435 commissioned ...ers, and 17,159 non-commissioned officers and privates. The several depôts are stationed at Plymouth, Portsmouth, Woolwich, and Chatham, which ports they garrison, the head-quarters of the artillery being Portsmouth. The latter are dressed in blue with white facings, and the former in a scarlet uniform with blue facings. The marines annoy the enemy at sea by a fire of musketry, directed from the tops or deck, and they also repel by means of their bayonets any attempt made to board the ship. This gallant corps has also distinguished itself in duty on shore, and shared victoriously in the capture of Belleisle, the battle of Bunker's Hill, the defence of Acre, and also, under the command of Lord John Hay, on the coast of Spain during the Peninsular war. The officers of the Royal Marines take their rank by seniority, up to the step of lieutenant-colonel, there being no system of purchasing, as in the army.—Ref. *English Cyclopædia—Arts and Sciences.*

MARITIME LAW, *măr'-e time* (Lat. *mare*, the sea), as a branch of international law, is that collection of principles and usages that pertains to the rights, duties, and obligations of nations with respect to the

sea. (*See* Law of Nations.) It forms also an important branch of the commercial law of all maritime countries, relating more especially to individuals, to the property of ships, the rights and duties of masters and seamen, contracts of affreightment, average, salvage, &c. Besides the general maritime law, every commercial state has certain admiralty regulations of a municipal character, peculiar to itself; as navigation acts, laws with respect to harbours, obstructions in rivers, wrecks, &c. Cases arising under these laws fall within the jurisdiction of the *maritime courts*. These are, in this country, the Court of Admiralty (which *see*), and its court of appeal, the Judicial Committee of the House of Lords, together with the courts of Vice-Admiralty, established in her majesty's possessions beyond the seas, with jurisdiction over maritime causes. To Rhodes belongs the honour of having framed the first authoritative code of maritime laws, which was the source of the maritime jurisprudence of the Romans. Fragments of this code are preserved in the Digest of Justinian, under the title *De Lege Rhodia de jactu*; and these fragments, together with a few brief rules of the Roman law, embraced in the works of Justinian, are all that remain to us of the maritime law of the ancients. These, nevertheless, constitute the basis of modern maritime law in some of its most important principles. The earliest code of modern sea laws was compiled for the republic of Amalfi towards the end of the 11th century, and is known as the Amalfitan Table. Though mentioned by authors as being in existence as late as the 16th century, it has since been entirely lost. The next work of this nature is the "Consolato del Mare," a collection of the maritime laws and usages observed by the commercial cities of the Mediterranean at the time of its compilation. Its origin is involved in some obscurity, the Spaniards claiming the honour of its paternity for Barcelona, where it appeared about the middle of the 13th century; while others contend that it was the production of the Pisans about two centuries earlier. The earliest maritime code of Western Europe is known as the "Laws of Oleron," the origin of which, like that of the Consolato, is involved in obscurity. Earlier English writers contend that these laws were compiled by Richard I. at the isle of Oleron, on the coast of France; while French writers maintain that they were prepared by order of Queen Eleonora, duchess of Guienne, and mother of Richard I. Recent authors reject both stories, and now the general opinion seems to be that they were compiled in France in the reign of Louis IX. They were the estatablished regulations of the early commercial states of Western Europe, and are still respected in England, France, and the United States. "The Laws of Wisbury," or Wisby, once an important city of trade in the island of Gothland, were promulgated about the year 1288. They are still observed in their fundamental principles by the nations of the Baltic, and are deservedly received with respect in the courts of this country. The Hanse towns compiled and adopted a system of their own, based principally upon the laws of Oleron and Wisbury, in 1591. It was afterwards corrected and enlarged at a general assembly of the deputies at Lubeck in 1614, and became the rule of decision in every contested point. In France, under the reign of Louis XIV., and at the instigation of his minister Colbert, the marine ordinances of 1673 and 1681 were issued, enlarging the foundations of maritime law, arranging its parts, and out of various materials constructing a harmonious system. The former of these ordinances treats largely of bills of exchange and negotiable paper; the latter embodies, in systematic order, the subjects of navigation, shipping, insurance, and bottomry. The present commercial code of France, adopted in 1807, is substantially but a republication of the ordinances of 1673 and 1681. In this country, no system or code of maritime law has ever been issued by authority. The laws and practices that guide us in reference to maritime affairs are founded principally on the practices of merchants, the principles laid down in the civil law, the laws of Oleron and Wisbury, the judicial decisions of our own and foreign countries, &c. The decisions of Lords Mansfield and Stowell have done much to fix the principles and to improve and perfect the maritime law of England.—Ref. *A Treatise on Maritime Law*, by Henry Flanders.

Marjoram. (*See* Majorana and Origanum.)

Mark, St., Gospel of, *mark*, is the second in order of the four gospels of the New Testament. St. Mark was not an apostle or companion of Jesus Christ during his ministry; but is said, by tradition, to have been secretary of Peter, and to have written his gospel according to the discourses of that apostle. Some assert that a number of those who had publicly listened to Peter's preachings at Rome had entreated Mark, as he had been a long time the apostle's companion and had a clear understanding of what he had delivered, that he would commit the particulars to writing. The minuteness with which the various circumstances are recorded shows that the person who dictated it must have been an eye-witness of what has been recorded, while the great humility with which Peter is always introduced, his weakness and fall being fully exposed, give colour to the tradition that it proceeded principally from him. Some critics have maintained that this gospel is merely an abridgment of that of Matthew; and there certainly occur many striking coincidences between them, both in style and words; but the frequent deviations of Mark from the order in time and arrangement of facts observed by Matthew, as well as the introduction of many things not noticed by the latter, are opposed to this view. This gospel was originally written in Greek; but from the number of Hebraisms discoverable in it, there can be little doubt that its author was, by birth and education, a Jew; while, on the other hand, its numerous Latinisms show that it was composed by a person who had lived among the Latins. The authenticity of this gospel is proved by the unanimous testimony of the early fathers. Some critics have thought that the last twelve verses of the 16th chapter were not written by the evangelist, as they are not to be found in some of the ancient manuscripts; but there is nothing to oppose the view that they may have been written by him at a later period, and thus some copies been in circulation without them. Considerable difference of opinion exists as to the time when this gospel was written; some placing it as early as 56, others after Peter's death, as late as 65. The probability seems to be that it was written about 63 or 64. It consists of sixteen chapters, and may be divided into three parts;—viz., 1. Containing an account of the transactions from the baptism of Christ to his entering on the more public part of his ministry (i. 1—13); 2. the discourses and actions of Christ to his going up to Jerusalem to the fourth and last passover (i. 14—x); 3. the passion, death, and resurrection of Christ (ix.—xiv.). From the style and character of the book, there can be little doubt that it was written for Gentile Christians. The explanations that are introduced would have been unnecessary if it had been written exclusively for Hebrew Christians, as, where he uses the word *corban*, he adds "that is, a gift." This gospel is characterized by clearness, exactness, and conciseness, combined with an almost picturesqueness of narration. Indeed, it has been said that, considering the copiousness and majesty of the subject, the variety of great actions which it relates, the surprising circumstances that attended them, and the numerous and important doctrines which it contains, it is "the shortest and clearest, the most marvellous, and at the same time the most satisfactory, history in the whole world."—*Ref.* Horne's *Introduction to the Holy Scriptures*.

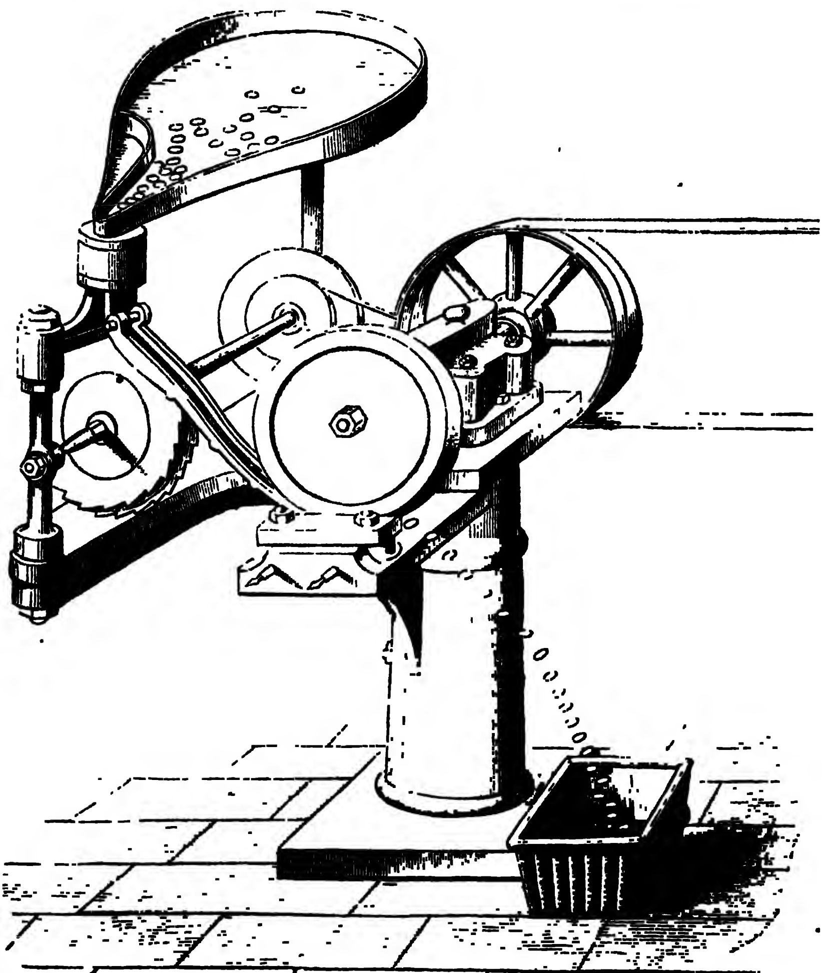
Mark is an old English term for a coin formerly current. Its value was two-thirds of a pound sterling, or 13s 4d. The Scotch mark, or merk, was two-thirds of a pound Scots, or 13⅓d. sterling. It is also the name of a weight used in several parts of Europe, and for several commodities, especially gold and silver. In France and Holland, the mark equalled eight ounces.

Market, *mar'-ket* (Lat. *mercatus*), in Law, is an appointed place and fixed time for the meeting of buyers and sellers. A market can be set up only by virtue of a royal grant, or by immemorial usage, which presupposes a grant. A grant to hold a market must not be prejudicial to others, more especially to the owners of existing markets; and hence the first step of the crown, with the view to confer such grant, is to

issue a writ *ad quod damnum*, directed to the sheriff of the county, authorizing him to summon a jury to inquire whether the proposed grant would damage the queen or any of her subjects. Formerly, markets were held chiefly on Sundays, and frequently in church-yards; but statutes were subsequently passed prohibiting these. Sales in markets may be either of goods actually brought to the market, or of goods not so brought, the latter being generally by sample.

MARKING-INK. (*See* INK.)

MARKING-MACHINE.—Annexed is a drawing of a very effective machine for performing one of the numerous operations in connection with the process of coining. It is the invention of Mr. Meredith Jones, of the Royal Mint. It is called a marking-machine; but as that title does not convey to those who are unacquainted with the processes of money-making any exact idea of its nature, we may venture briefly to describe its uses. Every properly manufactured coin has raised edges on its circumference, which are intended to preserve the engraved surfaces from abrasion. As blank dies of metal intended for coins are struck forcibly between steel dies to "get up" their impressions, it is obvious that the edges of which we speak would, in order to be brought out prominently, demand a very heavy strain. This strain would, probably, fracture the dies, and thus lead to great expense and inconvenience. The marking, or "edge-compressing" machine, as we should be disposed to call it, is intended to avoid this evil. It raises the edges of blanks before they are passed forward to the stamping-presses, and thus prepares them to receive the intended heading which ornaments current coin, and the moulded rims which protect them from rapid defacement. One of these machines is at present employed in the Royal Mint to mark blank discs of gold, silver, and bronze. The operation of the machine is as follows:—A bag of bronze pieces we will suppose to have been discharged upon the flat feeding-pan of the machine: the feeding-pan is placed at such an angle as to give the pieces a strong inclination to fall into a tube at its base. The



machine is set in motion, and a notched disc of steel, revolving vertically to the horizon, and immediately below the feeding-tube, carries forward the lowest piece of bronze in the tube to a brass spout placed directly in front of it. This spout is a conductor to the marking-disc situated below it, and quickly the piece slides horizontally towards the latter, which is revolving at a rapid rate. Arrived at this point, it is caught in a groove in face of the disc, and this causes it to rotate two or three times between the disc and a fixed "check," having a corresponding groove on the opposite side, and then discharges it into the basket. Set screws at the back of the check allow of its adjustment at any distance from the running disc, and thus to adapt the machine for any sized blanks which it may be required to pass through it. The blank, after its dismissal, will be found to have its edge thickened at the expense of its diameter, and thus the sharp corners which it presented after punching from the sheet have been rounded off. It is, in fact, a "marked" piece. The machine disposes of about 700 pieces per minute. Through the courtesy of the proprietors of the *Mechanics' Magazine* we are enabled to give an engraving of this machine.

MARKING-INK. (*See* INK.)

MARKING-NUT. (*See* SEMECARPUS.)

MARK, ORDER OF SAINT, is the name of a Venetian order of knighthood, said to have been established in honour of St. Mark, the patron saint of that republic. The doge, as well as the senate, elected knights, who enjoyed a pension. Foreigners also, particularly learned men, were elected.

MARL, *marl* (Welsh), strictly speaking, is clay containing carbonate of lime; but the term is now loosely applied to any clayey earth used in fertilizing land.

MARMOT, *mar'-mot* (Ital. *marmotta*) (*Arctomys*), a gen. of rodent animals, of which there are many types. Cuvier observes, with regard to the marmots, that they have five molar teeth on each side above, and four below, bristling with points; accordingly, some species are easily induced to feed on flesh, and will eat insects as well as vegetables. They are short-legged animals, with a tail round and rather short; they also possess a large and flattened head. They pass the winter in a state of torpor, in deep holes, the entrance of which they close up with hay. They are generally gregarious and are easily tamed. The Alpine marmot (*Arctomys alpinus*) is about as large as a rabbit, with a short tail, and covered with a yellowish-grey fur, varied with ash-coloured tints towards the head. This species inhabits the Alps and Pyrenees just below the region of perpetual snow. The Polish marmot is about the same size as the one last mentioned, and of nearly the same colour. It inhabits small hills, and mountains which are but slightly elevated, in Poland, and it frequently burrows in the hardest soils. Besides these, there are many other European and Asiatic specimens. In conclusion, it may be observed that the marmots partake of many of the characteristics of the squirrels, and that they are both herbivorous and carnivorous. The American marmot (*Arctomys ludovicianus*) will be found described under the article PRAIRIE DOG (which *see*).

MARONITES, *mar'-o-nites*, in Eccl. Hist., are a sect of Christians in Asiatic Turkey, dwelling principally about Mount Lebanon. Their origin, and the derivation of their name, are matters of some uncertainty; but the prevailing opinion is, that they were called either after a hermit Maro, who lived in the 5th century, or after their first patriarch, John Maro, who flourished two centuries later. The general opinion is, that the Maronites are sprung from the Monothelites, who arose in the 7th century, and held the opinion that Christ, though he united in himself the divine and human nature, had but one will. They were supported by several emperors, particularly Heraclius; but they were condemned and banished by Anastasius. In the country of Lebanon they became a warlike mountain people, and defended their freedom first against the Greeks and subsequently against the Saracens. At length, in 1182, they renounced Monothelitism and were received within the pale of the Roman Catholic church; yet they retained their ancient rites and ceremonies, and accepted no popish doctrines except the supremacy of the Romish pontiff. By this slight tie they still continue united to the Church of Rome. In 1584, Pope Gregory XIII. founded at Rome a Maronite college, from which they have since received most of their priests. In 1736, Clement XII. prevailed on a national synod to accept the resolutions of the council of Trent. They are, however, permitted to retain many of their old traditional usages; thus their priests are permitted to marry, receive the Lord's Supper in both kinds, use the Arabic language in the church service, &c. Their head is the patriarch of Antioch, whose residence, however, is the convent of Dair-al-Shafee, on Mount Lebanon. Every tenth year he has to give an account of the condition of the church to the pope at Rome. Under the patriarch are bishops and several other orders of clergymen. In the district of Lebanon there were upwards of 200 religious houses under the rule of St. Anthony; but in consequence of the recent war with the Druses, many of these have been destroyed. Their political constitution is that of a military commonwealth; the supreme government being in the hands of four chief sheiks, who are also their leaders in time of war. Their dependence on the Ottoman empire is little more than nominal, consisting merely in the payment of an annual tribute. In 1841 a fierce war raged between the Maronites and the neighbouring Druses, in which the former suffered greatly. In May, 1860, the war again broke out with unprecedented fierceness, the Druses being aided and excited by the Mohammedan population, and even by Turkish troops. The Maronites were soon overpowered; about 160 towns and villages were destroyed, and nearly their entire territory laid waste. Many of the people were cruelly massacred. At length peace was concluded; and to prevent the return of similar atrocities, the European powers, at a conference held at Paris, agreed upon an intervention in Syria for the protection of the Christians. The number of the Maronites is variously estimated from 150,000 to 500,000.

MARQUE, LETTERS OF, *mark* (Fr.), are commissions for extraordinary reprisals for reparation to merchants taken and despoiled by strangers at sea, grantable by the secretaries of state, with the approbation of the sovereign and council, and usually in time of war. By the law of nations, they are grantable whenever the subjects of one state are oppressed and injured by those of another, and justice denied by that state to which the oppressor belongs. The term, however, as commonly used, has come to bear a somewhat different signification. If, during war, a subject should take an enemy's ship without commission from the crown, the prize would belong, not to the captor, but to the crown. To encourage merchants and others to fit out privateers or armed ships in time of war, the lords of the Admiralty have been empowered, by various acts of parliament, to grant commissions to the owners of such vessels; so that the prizes captured by them may be divided between the owners of such vessels, their captains and crews. Before such commission is granted, the owners are required to give security to the Admiralty to make compensation for any violation of treaties with peaceful powers. These commissions are ordinarily termed letters of marque. During the late war with Russia, our government did not issue any letters of marque.—*Ref.* Wharton's *Law Lexicon*.

MARQUETRY, *mar'-ket-re* (Fr. *marqueterie*, *marqueter*, to inlay), a peculiar kind of inlaid cabinet-work, in which thin slices of different coloured woods, and sometimes of gold, silver, copper, tortoise-shell, mother-of-pearl, ivory, horn, &c., are inlaid and put on a ground. These substances, after being reduced to laminæ of proper thinness, are cut out into the required form by punches, which produce at once the full pattern, or mould, and the empty one which inclosed it; and both serve their separate purposes in marquetry. This species of inlaid work, when executed in glass, precious stones, or marble, is more commonly called mosaic.

MARQUIS, *mar'-kwis*, an English title of honour next in rank to that of a duke. This title has always been conferred by letters patent, and though of slow introduction, and, at first, seldom conferred, it now holds a conspicuous place among hereditary titles. The original duty of a marquis was to guard the marches, or frontier territories of a kingdom, from which circumstance the name is derived. The title was unknown

ALPINE MARMOT.

PINE-MARTEN.

FISHER-MARTEN.

in this country till 1387, when Richard II. conferred on his favourite, Robert de Vere, earl of Oxford, the title of marquis of Dublin for life. The first occasion upon which the title of marchioness is known to have been conferred was in the 24th of Henry VIII., when Lady Anne Rochfort received that dignity in her own right. An English marquis has this privilege over an earl, that his younger sons are addressed as "My lord;" as, Lord Robert Grosvenor, son of the marquis of Westminster; and Lord Dunkellin, son of the marquis of Clanricarde. In England, the marquises furnish the fewest number to the peerage of any rank of the nobility; as is also the case in Scotland; but in Ireland, where here is only one dukedom, the title of marquis is more frequent. The reign of George III. supplied the peerage with nearly all the existing marquisates.

Marriage, *mar'-ridj* (Lat. *maritagium*), is a solemn contract, dictated by nature and instituted by Providence, between two persons of different sexes, with a view to their mutual comfort and support, and for the procreation of children. The importance of regulating the nuptial alliance has been recognized in all civilized countries. In Old-Testament history, we find intermixed marriages of the worshippers of God with the heathen nations around them strictly forbidden by Divine authority. The ancient Greek legislators considered the marriage relation, as not merely of private, but also of public or general interest. By the laws of Lycurgus, criminal proceedings might be taken against those who married too late or unsuitably, as well as against those who did not marry at all. The great object of marriage they regarded as being the rearing of healthy progeny for the state. Among the Romans, marriage proper (*connubium*), by which the children became Roman citizens, could only take place between a Roman citizen and the daughter of a Roman citizen Between a Roman citizen and a female slave there was no *connubium*; and, in consequence, the children were not Roman citizens. Children were in the power of [illegible] father only when the fruit of a legal marriage T[illegible] Roman notion of marriage was that of a complete personal unity of husband and wife; for the dissent of either party, when formally expressed, could dissolve the relation. The Roman matron was in a much more favourable position, socially, than the Greek wife; for she shared in the honours and respect shown to her husband, presided over her household, and watched over the education of her children In all Christian communities, the marriage relationship is regarded as the most solemn of contracts, and, excepting in Protestant countries, it is regarded as a sacrament. In this country, although not a sacrament of the Church, yet until very recently it fell almost exclusively under the cognizance of the ecclesiastical courts. Now, however, the new court of Probate and Divorce exercises some of the functions that formerly fell to the ecclesiastical courts, especially in the matter of divorce (*See* **Divorce**.) Marriage being a mutual contract, it follows that each party must enter into it of his or her own free will, and also that neither of them labour under any legal disability,—as proximity of relationship, want of age or reason, a prior contract of marriage still subsisting, certain physical disabilities, &c. (*See* **Husband and Wife**.) Marriage is dissolved (1) by death, (2) by judicial separation, (3) by judicial dissolution. As regards the validity of a marriage, the general principle is that it is to be decided by the law of the place where it is celebrated; if valid there, it is valid everywhere; and if invalid there, it is not valid anywhere. The ecclesiastical law required, for the solemnization of this contract, that there should be not only a mutual contract of espousal, *per verba de præsenti*, or words in the present tense, but that it should be solemnized by a priest, without which it was not considered a complete legal marriage. The ecclesiastical law, however, has long ceased to govern this contract, and the principal acts which now bear upon it are 4 Geo. IV. c. 76, and 6 & 7 Will. IV. c. 85. The former of these acts prescribes the previous publication of the banns upon three successive Sundays in manner therein mentioned, in the church or chapel where the marriage is to be solemnized, or, in lieu thereof, a special license from the archbishop of Canterbury, or a common license from the ordinary of the place or his surrogate; and no license to be granted to marry in any church or chapel unless one of the parties has had his or her usual place of abode in the parish to which it belongs for fifteen days immediately preceding; and no marriage to be solemnized after more than three months from the publication of the banns or grant of the license. The act 6 & 7 Vict. c 76, provides, further, that a marriage might be celebrated upon a certificate of the superintendent-registrar of the district, with or without a license. The party intending to be married is to deliver to the superintending registrar of the district within which both parties have dwelt for not less than seven days (if in different districts, to the superintendent-registrar of each), a notice of his or her intention to marry in the form prescribed; the same to be entered into a book called the "Marriage Notice-Book," open at all reasonable times, without a fee, to persons desirous of inspection. Where the marriage is without a license, this notice, or a copy of it, is required to be suspended or affixed to some part of the superintendent's office during twenty-one successive days after the day when it was entered in the notice-book, after which, if no objections have been lodged, the registrar issues, at the request of either party, a certificate in the prescribed form, any time within three months of which the marriage may take place. If with license, the notice or copy does not require to be suspended or affixed in the office, and the certificate may be obtained after the expiry of one day after the entry of the notice; also, if the parties reside in different districts, the notice only requires to be entered in one; but a residence of fifteen days in place of seven is required in the district. Contracts to marry at a future time are recognized by law, and actions for the breach of them are by no means uncommon. The promises, however, must be reciprocal, and a woman is bound by such a contract as much as a man; but actions for breach of promise are not often br[illegible]ght by the man, nor would such be much [illegible]ured [illegible]rt or jury. The action may be brought [illegible], but not against one. The very words, manner, or time of the promise are not often provable, nor is it indispensable to do so. The defence in such cases is either usually a denial of the promise, or, if that be proved, anything that would make the marriage unlawful. But a previous and existing marriage of the defendant would not be a defence against such an action if unknown to the plaintiff at the time when the promise was made to her. Frequently it is attempted to prove the bad character of the plaintiff, and if this can be done, it forms a sufficient defence to the action; but if it fail, the attempt may be regarded by the jury as a ground for increasing the damages. But if the bad character was known to the defendant at the time of making his promise, it forms no defence, though it may be received in mitigation of damages. This contract, like any other, may be upon condition, and if the condition be reasonable, the law will respect it, and will not sustain an action on the promise unless the condition be performed.

Marriage Ceremonies.—In almost every country marriage is regarded as a season of rejoicing among the friends and relatives, and is celebrated with certain ceremonies. Respecting the customs of the ancient Persians, Babylonians, Indians, and other inhabitants of Asia, ancient writers have left us little or no information. A curious custom is said to have existed in Assyria of disposing of the marriageable girls by public auction; the money received for the best-favoured of them being given as portions with those whose charms were not sufficient to attract purchasers. [illegible] with the ancient inhabitants of the East, the [illegible] was obtained by presents made or services rendered to her parents, a practice which still prevails in some parts of that region. With the ancient Hebrews, an interval of ten or twelve months usually intervened between the betrothment and the celebration of the marriage. On the day of the wedding, the bridegroom proceeded, anointed and ornamented, accompanied by a friend (*paranymph*) and followed by several companions, into the house of the bride, and conducted her, veiled and followed by her companions, with songs of music (at a later period also with torches), into his or his father's house, where the wedding feast was celebrated at his expense. It generally lasted for seven days; but if a widow was married, only for three. The

bride and bridegroom were each adorned with crowns, and the conversation was enlivened by songs and enigmas. The duty of the paranymph was to play the part of the host at the feast. The men and women indulged themselves in feasting and conviviality in separate apartments. At length the nuptial blessing, viz., a numerous offspring, was implored upon the parties concerned (which appears to have been anciently the only ceremony performed in constituting the marriage), and the bride and bridegroom were led, the former still veiled, into the bridal chamber, where the bridesmaids accompanied them with torches and song. The wedding ceremonies of the modern Jews deviate considerably from those of their forefathers, though the rabbis maintain that they strictly follow the ceremonies observed at the wedding of Tobias. The Jews marry very young, and hold it to be a direct sin against the commandment given to our first parents if they are not married by their eighteenth or nineteenth year. Marriage is permitted to males at the age of thirteen years and a day,—to females at twelve years and a day. Barrenness is esteemed a great misfortune among them. After the suitor has obtained the consent of the girl and her guardians, the betrothment takes place with certain ceremonies, the bridegroom paying, or at least was formerly wont to pay, a so-called "morning gift," a remnant of the custom of buying the daughter from her father. The ceremony of the wedding generally takes place in the open air, seldom in a room, and usually on Wednesday. The couple sit under a canopy generally carried by four boys. A large black veil covers both, besides which, each of them has a black cloth (*taled*) with tassels at the four corners, upon the head. The rabbi, precentor of the synagogue or nearest relative of the bridegroom, offers the couple a cup of wine, saying, "Praised be thou, O God, that thou hast created man and woman, and hast ordained matrimony." Both then drink. The bridegroom puts a gold ring without a stone on the finger of the bride and says, "With this ring I take thee as my wedded wife, according to the custom of Moses and the Israelites." The matrimonial contract is then read, and the bridegroom shakes hands with the parent of the bride. Wine is again brought, prayers are spoken, the couple drink, and the cup is then broken. The company then proceed to the house of the bridegroom, where the marriage feast is held. Among the ancient Greeks marriage was accompanied by numerous ceremonies. It was usually preceded by a formal betrothment, when the bridegroom bestowed a present on the bride as a pledge of his honour. A dowry was usually given with the bride. At the nuptials, the betrothed pair, as well as the place of festivity, were adorned with flowers and garlands. (*See* BRIDE AND BRIDEGROOM.) The Romans had three different ways of concluding a marriage,—*confarreatio*, *usus*, and *coemtio*. The first of these was the most solemn, and was always preceded by a ceremonial betrothment, which often took place many years before the marriage of the parties. In fixing the day of marriage care was taken to select what was esteemed a lucky day, the month of May, the calends, nones, and ides, and the days following them, the feast of the Salarians, &c., were esteemed *atri dies* (black, or unlucky days). The confarreatio was when a man and woman were joined together in marriage by the pontifex maximus, or flamen dialis, in presence of at least ten witnesses, by a set form of words, and by partaking of a cake called *far* or *farreus panis*. There were certain offices in the priesthood that could only be held by the sons of parents who had been married in this way. Usus, or usage, was when a woman, with consent of her parents or guardians, lived with a man for a whole year without interruption, when she became his lawful wife by prescription. If the wife wished to avoid the legal consequences of a marriage, absence for three nights during the year from her husband was regarded as a sufficient legal interruption. Coemtio was a kind of mutual purchase, the marriage being effected by one delivering to the other a small piece of money, and repeating certain words. (For a further account of the Roman marriage ceremonies, as well as for those that formerly prevailed in this country, *see* BRIDE AND BRIDEGROOM.)

MARRIAGE SETTLEMENT is a conventional arrangement, usually made before marriage, whereby a jointure is secured to the wife, and portions to the children, in the event of the husband's death. It is based on what is called the "marriage consideration," which is the highest consideration known to the law, and may be made good against the husband's estate, and satisfied before any other debts. If made after marriage, it will, as a general rule, be fraudulent and void against all persons who are creditors of the husband at the time of the settlement, unless such settlement contain a provision for debts, or be made in pursuance of articles entered into before marriage. In case articles are entered into before marriage, and afterwards a settlement is made different therefrom, the court of Chancery will set up the articles against it; but where both are concluded prior to the marriage, when both parties were at liberty, the settlement will be taken as a new agreement. These settlements appear to have been in use among the ancient Gauls and Germans.

MARROW, *mar'-ro* (Lat. *medulla ossium*), in Anat., is a light fatty substance lodged in the interior of the bones. Like ordinary adipose tissue, it consists of vesicles containing fat, with blood-vessels distributed to them. It is usually of a yellow colour, with 96 parts of fat, 3 of water, and 1 of areolar tissue, in 100 parts. In some parts it is of a reddish colour. In birds, for the sake of lightness, the larger bones, instead of being filled with marrow, contain air, which passes into them from the lungs. In the fœtus the bones do not contain marrow, but a transparent reddish fluid like bloody serum, only more consistent.

MARRUBIUM, *mar-ru'-be-um* (Heb. *marrob*, a bitter juice), in Bot., a gen. of the nat. ord. *Labiatæ*. The species *M. vulgare* is the common horehound, which is much employed as a domestic remedy in coughs.

MARS, *marz*, in Astron., one of the principal planets in our system, the fourth in the order of distance from the sun, and consequently the next above our earth. The mean distance of Mars from the sun is 140,000,000 miles; it performs its sidereal revolution in 1 year, 10 months, and 21·93 days, and revolves on its axis in 24 hours, 39 minutes, 21 seconds. At the mean distance of the earth from the sun, the apparent diameter of Mars would amount to 8·9 seconds, an arc indicative of a real diameter of 3,976 miles. Of all the planets known in ancient times, Mars is the one which has the greatest eccentricity. When the planet begins to emerge from his conjunction with the sun, his disc appears perfectly round, at the time of opposition, for some days before and after, he exhibits the same form, at a greater distance, however, from the opposition, he exhibits a sensible phase, which never imparts to the planet the aspect of a crescent, nor even that of the moon at her first quarter, but attains its maximum at the quadratures. On the surface of Mars, permanent spots can be perceived, by means of which it has been proved that the planet revolves on an axis inclined at an angle of 59° 27′ to the plane of the ecliptic, or 61° 18′ to the plane of his orbit. In Mars there must be two different seasons analogous to those we observe on the earth. In proof of this may be mentioned a singular phenomenon which manifests itself towards the north and south poles of Mars. At these points are two whitish spots, the brilliancy of which is more than double that of the other parts of the planet. The north spot diminishes in size during the spring and summer of that hemisphere, and increases during the two following seasons: the contrary takes place at the south pole. From these facts it may be concluded that these form round the poles of Mars extensive coverings of a whitish substance similar to the snows which fall from our atmosphere. Among the Jews, the planet Mars bore a name which signifies fiery; the Greeks also, who called the planet Hercules, applied to it the epithet *pyroeis*, incandescent. Even at the present day, Mars is the object in the heavens which exhibits the most intense tinge of red. This colour, however, appears more intense to the naked eye than in a telescope. It is generally supposed that Mars possesses an atmosphere similar to our own.

MARSDENIA, *mars-de'-ne-ă* (in honour of William Marsden, F.R.S., secretary of the Admiralty), in Bot., a gen. of the nat. ord. *Asclepiadaceæ*. *M. tinctoria* produces a kind of indigo; *M. tenacissima* has very tenacious fibres, which are used for bowstrings by the mountaineers of Rajmahl.

MARSEILLAISE, THE, *mar-sale-yaize'*, is the name of the celebrated national song of France. It was composed by Rouget de l'Isle, an officer in the engineer corps at Strasburg, early in the French revolution. It was first called *L'Offrande à la Liberté*, and soon became very popular throughout the country, contributing in no small degree to the success of the revolutionary arms. It received its present name from being sung for the first time in Paris by a band of men who were brought from Marseilles by Barbaroux, to aid in the revolution of August 10, 1793. It has since continued to be the favourite song in all popular movements in France.

MARSHAL, *mar'-shăl* (Fr. *maréchal*), is a high title of honour in various European countries, though not of the same dignity in all. It is said originally simply to have meant a groom or manager of horses, and from the importance of such an officer among rude warlike nations, he came to be possessed of great military authority. The office of earl-marshal of England seems to have been introduced into this country by William the Conqueror. (*See* EARL-MARSHAL.) On the division of the Aula Regis, or King's Great Court, the earl-marshal appointed a deputy in each of the new courts, whose duty it was to take into custody all persons committed to him by the court. The marshal of the Queen's Bench had the custody of the Queen's Bench prison. There was also a marshal of the Exchequer, to whom that court committed the custody of the queen's debtors for se... debts. Both these offices have ... The marshal of France is the highest military rank in that country, as a field-marshal is in this. Marshal is also sometimes applied to a person who regulates the ceremonies on certain solemn celebrations.

MARSHALLING OF ARMS, *mar'-shăl-ling*, in Her., the arrangement and distribution of several coats of arms, belonging to distinct families, in the same escutcheon or shield, together with their ornaments, parts, and appurtenances, so as to denote the several marriages and alliances of the families.

MARSHALSEA, *mar'-shal-se*, was the name of a court originally held before the steward and marshal of the royal house, for administering justice in cases in which the sovereign's domestic servants were concerned, that they might not be drawn into other courts. This court being ambulatory, Charles I. erected a new court of record, with authority to try all manner of personal actions whatsoever which might arise between parties within twelve miles of the royal palace at Whitehall, not including the city of London. This court was abolished by 12 & 13 Vict. c. 101, as was also the old Marshalsea prison.

MARSH-MALLOW. (*See* ALTHÆA.)

MARSH'S TEST FOR ARSENIC, in Chem., a method of testing for arsenic, which consists in forming arseniuretted hydrogen, and afterwards depositing the metal from it. A wide-mouthed bottle is charged with a little pure granulated zinc. Through the cork pass two tubes, one of which reaches to the bottom of the bottle; the other, which passes only just through the cork, is bent at right angles, and drawn out to a capillary orifice. Distilled water is then poured through the first tube, and afterwards a little pure sulphuric acid. Hydrogen is immediately evolved, and as soon as the whole of the atmospheric air h... been expelled, the gas is tested for ars... presently to be described. If found ... the ... pected material is added to the ... of ... bottle, when, if arsenic be present, arseniuretted hydrogen is immediately evolved. The presence of arsenic in the gas is detected in two ways,—by heating the tube through which it passes with the flame of a spirit-lamp, and by burning it as it passes out of the capillary orifice. In the first case, a metallic ring will be formed in the tube; in the second, a metallic mirror will be formed on holding a piece of cold porcelain in the flame. The ring and mirror may possibly be antimony: this, however, is determined by touching them with a drop of hydrosulphate of ammonia, when, if formed by antimony, they will disappear, but the arsenic will be entirely unacted upon. A confirmatory test may be applied in the form of a drop of a dilute solution of chloride of lime, the arsenic dissolving, and the antimony remaining in this case. Marsh's test is one of extreme delicacy, and very easy of application. The principal difficulty attending its use is the liability of the organic matter contained in the suspected material to froth up and cause inconvenience. This may be obviated by adding to it one-tenth of its bulk of hydrochloric acid and a small quantity of chlorate of potash. This destroys the organic matter, and renders the test perfect in its mode of application. It is hardly necessary to state that all the materials used must be rigorously tested for arsenic beforehand, otherwise serious mistakes may arise,—as in the famous Smethurst case, in which Dr. Taylor, in applying Reinsch's test, used copper wire containing a notable quantity of arsenic. (*See* also ARSENIC and REINSCH'S TEST.)

MARSILEACEÆ, *mar-sil-e-ai'-se-e* (after Count Marsigli, founder of the Academy of Sciences, Bologna), in Bot., the Pepperwort fam., a nat ord. of *Acotyledones*, sub-class *Acrogenæ*, consisting of aquatic herbs with small floating or creeping stems. They are widely distributed, but are most abundant in temperate regions. There are four genera and about 20 species. Their properties are unimportant.

MARSUPIALIA, or MARSUPIATA, *mar-su-pe-ai'-le-ă, -su pe-ai'-tă* (Lat. *marsupium*, a bag), a term applied to ... group of mammalia, which differ altogether from others, both by their organization and by the different varieties of nourishment which they consume. As a necessary consequence to these peculiarities, we find their structure altered, accordingly, and we find among them the organs of progression, prehension, and digestion, so adapted to their various wants and habits, that we may trace in them ...me of the prominent characteristics of the carnivo...us, insectivorous, herbivorous, and rodent forms of other mammalia. Scaliger christened the first species of marsupialia brought under the notice of ...logists, by the name *Animalia crumenata*; that is, ... words, Purse-bearing animals. The leading feature in the ... als is the premature birth of their young, which are nourished, after their exit from the uterus, by the pouch or marsupium of the mother, in which the teats are placed, to which latter they attach themselves immediately on birth. The ursine ...possum is an instance of this class, and is a native of Van Diemen's Land. The great type of the genus, however, is the KANGAROO, a description of which will be found ... article bearing that name. (*See* KANGAROO, OPOSS...M, SQUIRREL, &c.)

MARTELLO TOWERS, *mar tel'-lo*, a series of circular fortifications, cons...ng of towers of two stories high, ...ted along the Kentish coast, in Ireland, Jersey, and in other parts, in order to repel the threatened invasion of Napoleon Buonaparte in the early part of the present century. The buildings are formed of masonry, the first story being divided into chambers, for the reception of stores, and the upper portion being casemated, and serving for troops: the room is bomb-proof. They were erected at intervals of about a mile between each. The wall of the building terminates above in a parapet, while on the terre-plein of the roof are placed pieces of artillery which rest on traversing platforms of timber, which can be moved all round in order that the guns may be fired in any direction. The whole work is generally surrounded with a ditch and glacis, and the entrance is some considerable height from the ground, and above it ...chicolations. The name of these towers is derived ...ne built at Martella Bay, in Corsica, which afforded a determined resistance to the English troops in the year 1794. The martello towers in Ireland are generally termed round towers. These, at the present time, are usually devoted to the service of the coast-guard force.

MARTEN, *mar'-ten* (Du. *marter*), an elegant little animal, belonging to the family *Mustelidæ*, or Weasel tribe. There are two varieties of this species; namely, the beech marten and the pine marten; the former being possessed of a white throat, and the latter of a yellow one. The beech marten (*Mustela Martes*) differs but little from the weasel in form, with the exceptions of the body being slightly more elongated, the head a little more pointed, and the fur generally longer. The martens have also an additional molar tooth in both jaws, and also the larger grinder of the lower

jaw has a small internal tubercle, which does not exist in that of the weasels. The tail is about as long as the body; the upper parts greyish or yellowish-brown, and the feet and tail of a chocolate hue; the throat has already been described. The limbs are of moderate length; on the fore foot the first toe is very short, the second and fifth equal in length, and the fourth the longest; on the hind foot the proportions are similar: the soles of all are covered with hair, and the claws are large, compressed, tapering, and arcuate,—that is to say, linear and bent like a bow. The fur is dense, rather soft, and long, being longer on the hind parts, especially on the tail. The under fur is thick and woolly. When young, the marten is of a darker colour, and in summer the fur is always of a lighter hue than in winter. The marten is generally distributed throughout England and Scotland, and in E[illegible] of Scotland, it is termed the taghar and polecat. In its habits it partakes of the qualities of the fox, as it is a destructive depredator at night-time of farm-yards, although it shuns men as much as possible. Its general length, from nose to tail, is about a foot and a half. The female has two litters, at least, in the year, and produces two or three cubs at a time. The *pine marten* is an inhabitant of North America, where it frequents the woody districts from the Atlantic to the Pacific: it is also found about the region of Mount Caucasus, in Europe, and even in Sweden and Norway. These martens are very destructive to small game and the eggs of birds, their lives being one continual plundering of the nest of the partridge, the retreats of the squirrel, and the *form* of the hare. When deprived of these, they prey on field-mice, dormice, and even lizards and serpents. When the time has arrived for the female to bring forth her young, she takes forcible possession of a squirrel's nest, and enlarges it so as to suit her requirements. The skins of the pine marten are imported in large quantities into Great Britain, as their fur is much used by furriers; upwards of 100,000 being annually brought into the country. (*See* also WEASEL.)

MARTIAL LAW, *mar'-she-al* (Lat. *martialis*, pertaining to war), is often confounded with military law, but the terms are by no means synonymous. "Martial law" is defined by an old authority to be "the law of war, that depends on the just but arbitrary power and pleasure of the king. For though he doth not make any laws but by common consent in parliament, yet in time of war, by reason of the necessity of it, to guard against dangers that may often arise, he useth absolute power, so that his word is a law." When in time of extreme peril to the state, either from without or within, the general safety cannot be trusted to the ordinary administration, or the public welfare demands the adoption and execution of extraordinary measures, it may become necessary to declare the existence of martial law. It is sometimes known as drum-head law, complete submission being enforced by military authority, and all acts of insubordination punished summarily on the spot. In public riots, when the military are called out, and the Riot Act read, a species of military law is enforced. Military law, on the other hand, is the code of regulations, con[illegible] the Artic'es of War, which are used for the [illegible] of the army and navy. It does not supersede the general municipal law, but is rather a branch of it. The special tribunals employed for the [illegible] tion of this law are termed courts-m[illegible] officer [illegible] to military law, therefore exempt from being [illegible]ded against by the ordinary course of law, and where h[illegible] accused of any offence against a subject of the realm, punishable by the known law of the land, he shall be delivered over to the civil magistrate. No person can by the Articles of War be subjected to any punishment of transportation, or any punishment extending to life or limb, for any crime which is not expressed to be so punishable by the Mutiny Act itself, nor shall be punished in any manner or under any regulations which shall not accord with its provisions.

MARTIN. (*See* PISTACIA.)

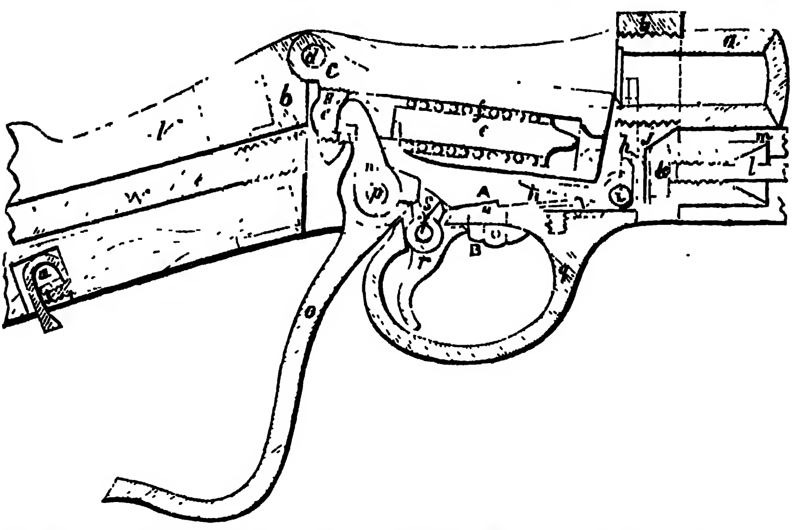
MARTIN, *mar'-tin* (Fr. *martinet*), *Hirundo urbica*.—This bird belongs to the *Hirundinidæ* or Swallow fam., a class of birds belonging to the ord. *Passeres*, tribe *Fissirostres*, and sub-tribe *Fissirostres diurnæ*. The martin usually makes its appearance in this country a few days later than the swallow. It appears to commence its northern migration in Africa, crossing the Mediterranean along with the swallows; but its wings being on a smaller scale, it is prevented arriving so soon as the larger-winged bird. It always endeavours, like the swallow, to establish itself near the habitation of man, and as it is not a destructive bird to plants or grain, it is usually regarded with favour. The nest of this bird is generally fixed under the eaves of houses, or in the upper angles of windows; whence its name of *house-martin* and *window-martin*, according to Mr. Yarrell. The nest is built of clay, which is laid on in alternate strips, day after day, until the whole is completed. After the exterior wall is finished, the cavity within is lined with hay and soft feathers. The [illegible] produces three, and occasionally four broods in the season. The eggs are four or five in number, and are smooth and white. After incubation and hatching has been completed, which operation lasts thirteen [illegible]s, the parent birds devote themselves to feeding [illegible] nestlings. The little birds put out the head on the arrival of the food, and eagerly receive it from the beaks of the old ones. The martin is one of the most regular of summer visitors to this country, and considerable numbers also go to Denmark, Sweden, and Norway, some even as far north as Lapland. It leaves about the middle of October; and if any of its last brood are unfledged, it deserts them without the slightest compunction. In the adult male the beak is short and black; the top of the head and back of a glossy bluish black; the wing and tail dull black; the chin and under surface of the body white; and the claws curved, sharp, and of a greyish horn-colour. The whole length is slightly more than five inches and a quarter; and from the carpal joint to the end of the first quill-feather of the wing the extent is about four inches and a quarter. The *sand martin*, or *bank martin*, is another variety. This bird is the smallest of the *Hirundinidæ* that visit this country, as it is also the earliest. The whole length is about four inches and three-quarters. The beak of the adult birds is dark brown, the irides hazel; the head, with back and wing-coverts, as well as tail-coverts, of a mouse-brown colour; the throat, breast, and under surface of the body, pure white; and the legs, toes, and claws, dark brown, with a few short buff-white feathers on the posterior edge of the tarsus, just above the junction of the hind toe.—(*Yarrell.*) The American purple martin (*Progne purpurea*) is a visitor to North America, where it arrives in February at New Orleans, and Boston towards the end of April. The colour of the male is a rich deep purplish blue, with the wings and tail brownish black: the female is of a more dusky appearance and has the under surface of the body varied with yellowish stains. The purple martin feeds on the l[illegible]ged insects; as wasps, bees, &c. It builds its [illegible]ks and grass about ten days after its arrival, and lays from four to six eggs. Audubon the naturalist observes of this bird, with regard to the estimation in which it is held: "I [illegible] a large and commodious box built and fixed on a pole for the reception of the martins, in an inclosure [illegible] my house, where, for some years, several pairs had reared their young. The erection of such houses is a general practice, the purple martin being considered as a privileged pilgrim, and the harbinger of [illegible]." In its flight, the purple martin resembles the [illegible] martin first mentioned, and it sweeps along at a short distance from the level of the ground, in the pursuit of its favourite prey. Some specimens of this bird have been shot in England. (*See* also SWALLOW FAMILY.)

MARTINET, *mar-ti-net'*, in military language, a phrase applied to a severe disciplinarian. The term is said to be derived from a Colonel Martinet, of the army of Louis XIV. of France, who was notorious for his rigorous conduct, and who invented a peculiar whip, called by his name, for the purpose of military punish[illegible]. In nautical phraseology, martinets are small [illegible] fastened to the leech of a sail, and reeved through a block at the masthead, coming down the mast to the deck. Their use is for facilitating the furling of sails, as they bring the leech close to the yard.

MARTINI-HENRY RIFLE.—This form of rifle was adopted by the Government upon the recommendation

of a committee of investigation formed in 1868. After many thorough and careful trials of various forms of rifle, this committee advised the adoption of the Martini breech mechanism, with the Henry barrel and rifling, and the Boxer ammunition. Mr. Greener, in his recently published work upon breech-loading guns, explains that the breech of the Martini has been allied with the barrel of the Henry rifle, each of these separate parts having been proved the best of their kind. The action of this breech will be presently explained. In the engraving the construction of the weapon is clearly shown: *a*, barrel; *b*, body; *c*, block; *d*, block axis-pin; *e*, striker; *f*, main-spring; *g*, stop-nut; *h*, extractor; *i*, extractor axis-pin; *j*, rod and fore-end holder; *k*, rod and fore-end holder screw; *l*, ramrod; *m*, stock fore-end; *n*, tumbler; *o*, lever; *p*, lever and tumbler axis-pin; *q*, trigger-plate and guard; *r*, trigger; *s*, tumbler-rest; *t*, trigger and rest axis-pin; *u*, trigger and rest-spring; *v*, stock-butt; *w*, stock-bolt; *x*, lever catch-block spring and pin; A, locking-bolt; B, thumb-piece. The experiments which led to the incorporation of the Henry and the Martini weapons were carefully carried out. A comparison was taken between the two on the several points of safety, strength, number and simplicity of parts, facility of manipulation, and cost. Under the heads of safety

The Martini action was accordingly wedded to the Henry barrel at the Enfield manufactory. The breech action of the rifle is sufficiently simple. The breech is closed by a block which swings on a pin, passing through the upper rear end of the shoe. The cartridge is exploded by a direct-acting piston, which is driven by the action of a strong spiral spring within the breech-block. This block is acted on by a lever to the rear of the trigger-guard. The act of pushing the lever forward causes the block to fall, the spring to be compressed, and the empty cartridge-case to be ejected. On drawing back the lever, the block is raised so as to close the breech, and the arm is ready to be fired. It is provided with a safety-bolt. The indicator at the side shows if the arm is cocked or not. In order to facilitate shooting, an improved sight, similar to that known as the Whitworth sight, has been adopted. The total cost of the weapon is estimated at £2. 18s. 9d., as against £2. 13s. 2d. Its weight is 9 lb. 4½ oz., against 9 lb. 2 oz. for the service Snider-Enfield. Many objections have been raised against the Martini-Henry as a weapon for the English troops. To these the well-informed writer in the *Cornhill*, whom we have already quoted, remarks that of these objections the only one which appears to merit serious consideration, is the question of a spiral spring; but this appears to be more



and strength both arms were considered equal. In regard to the number and simplicity of parts, the Martini has the advantage. It has only thirty parts against forty-nine in the Henry, while the extractor-plate soldered on to the barrel of the latter arm is considered a disadvantage. In facility of manipulation the Martini, owing to the absence of a hammer, has the advantage. And in the Henry there is the possibility—as was discovered during the trials—of placing the cartridge in front of the extractor, and thus temporarily disabling the arm. Finally the Martini is stated to be rather the cheaper arm of the two. Moreover, the committee prefer a gun without, to one with, a side lock, in consequence of the liability of the lock to become "wood-bound" when exposed to wet, to say nothing of the additional operations and the multiplication of parts entailed. "Thus it came about that the Martini action was in the end preferred to the Henry; and as it is safer than the Snider action, without safety-bolt, and stronger, has fewer parts (the Snider without safety-bolt has thirty-nine), is quicker

than half answered by the successful performances of the Snider, which contains no less than three spiral springs, in the cold of Canada, the heat of India, and the variable temperature of Abyssinia; by the fact that the French and Prussians both employ spiral springs as the essential principle of action of their military arms; and that they show no disposition to abandon this element, whatever other changes may be made in their army; and by the absence of any appearance of failure in this spring, throughout the long and severe trials of the Martini. Further, it may be added, by way of general remark, that the breech mechanism has been submitted to the examination of practical mechanics, who have expressed their opinion that the construction and fitting of the several parts is mechanically correct. With the breech-loaders, some repeating arms were submitted to the committee, but they were none of them sufficiently perfect to justify their adoption. Moreover, the practical value of repeaters has diminished in proportion as the rapidity of fire of single breech-loaders has increased.—Ref. *Cornhill Mag.*, vol. xix.

Martinmas, *mar'-tin-mās* (*martin* and *mas*), is the feast of St. Martin of Tours, held on the 11th of

November, and often corrupted to Martilmass, or Martlemas. It is the third of the four cross quarter days of the year.

MARTYR, *mar'-ter* (Gr. *martur*, or *martus*, a witness), is generally applied to one who has suffered death on account of his religious opinions. In the early Church, many suffered in this way at the hands of the Romans, bearing witness to the truth of Christianity with their blood. Many of these underwent, with astonishing fortitude, the most cruel tortures, and doubtless in this way contributed greatly to the spread of Christianity. Those who suffered persecution on account of their faith, but short of death, were called Confessors. The martyrs were supposed to enjoy very peculiar privileges. According to some, they passed at once to the full enjoyment of heaven, for which others had to wait till the day of judgment. Martyrdom was thought so meritorious that it was called the second baptism, or baptism in blood; and in any case in which a catechumen was apprehended and slain for the name of Christ before he could be admitted into the Church by baptism, his martyrdom was deemed sufficient to answer all the purposes of that sacrament.—Ref. Ruinart's *Acta Martyrum*; Dr. C. Middleton's *Free Inquiry into the Miraculous Powers supposed to have subsisted in the Christian Church*; Gallonius, *De Sanctorum Martyrum Cruciatibus*.

MARTYROLOGY (Gr. *martur*, and *logos*, a discourse) is a catalogue or list of those who have suffered martyrdom in the cause of Christ, with an account of their lives and sufferings. Martyrologies are very numerous; but many of them contain very absurd and ridiculous narratives. The Martyrology of Eusebius was celebrated in the early Church, and was translated int Latin by Jerome; but it is now lost. Among Protestant martyrologies is Fox's "Book of Martyrs," which is a valuable record of the sufferings of the English reformers.

MARTYRS, FESTIVALS OF THE, in the early Church were occasions on which the Christians assembled at the graves of the martyrs, when orations in commendation of their deeds and sufferings were delivered, praise and thanksgiving offered unto God, and the Lord's Supper administered. On these occasions, the rich bestowed largely of their goods among the poor.

MASONRY, *mas'-son-re* (Fr. *maçonnerie*), the art of cutting stones and building them into a mass, so as to form the regular surfaces which are required in the construction of an edifice. The chief business of the mason is to prepare the stones, make the mortar, raise the wall, with the necessary breaks, projections, arches, apertures, &c.; and to construct the vaults, &c., as indicated in the design. A wall built of unhewn stone, whether it be built with or without mortar, is called a *rubble wall*, and this kind of work is of two kinds,—coursed and uncoursed. In the former case, the stones are gauged and dressed by the hammer, and the masonry, which may be of different thicknesses, is laid in horizontal courses. In uncoursed rubble, the stones are placed promiscuously in the wall, without any attention being paid to their being placed in courses. Walls are also built with ashlar facings and rubble masonry in brick backing. In either case thorough stones, to bind the mass together, ought to be introduced. The subject of walling forms the basis of the art of masonry; when, however, it comes to be applied to the construction of domes, groins, and circular arches, it becomes difficult and complicated, depending upon a thorough knowledge of descriptive geometry.

MASONRY, FREE. (*See* FREEMASONRY.)

MASQUE, *mask* (Fr.), a species of dramatic performance at one time greatly in vogue. It appears to have originated from the custom in processions and other solemn occasions of introducing personages in masks in order to represent different characters. Many of these, even in the religious shows of Italy, were of a grotesque nature, and the performance was often mingled with buffoonery. On the introduction of the masque into this country, a dramatic character was added to the exhibition. During the progresses of Queen Elizabeth, monologues or dialogues in verse were often recited by masked performers; and in the reign of James I. masques had assumed all the forms of dramatic compositions. With the exception of Milton, who wrote the magnificent masque of "Comus," the only classical English writer who devoted much labour and taste to this class of exhibition was Ben Jonson. His productions were acted at court, and the queen of James I. and Queen Henrietta Maria took part in some of them. During the reign of Charles I., the taste for masques died out, and never came into fashion again after the Commonwealth.

MASQUERADE, *mask-e-raid'* (Ital. *mascherata*), a term applied to a species of amusement, in which persons of both sexes mask or disguise themselves, and engage in dancing, festivities, or miscellaneous conversation. Masquerades are said to have been the invention of Granacci, an Italian, who lived in the beginning of the 16th century. In Italy, they were fashionable in 1512, and during the reign of Henry VIII. they were first introduced into England. Says quaint old Hall, in his "Chronicle:"—"On the daie of the Epiphanie at night (1512-13), the king (Henry VIII.), with a xi. others, were disguised after the maner of Italie, called a maske, *a thyng not seen afore in Englande*, thei were appareled in garmentes long and brode, wrought all with gold, with visers and cappes of gold, & after the banket doen, these maskers came in, with six gentlemen disguised in silk, bearying staffe torches, and desired the ladies to daunce; some were content, and some that knew the fashion of it refused, because it was not a thing commonly seen. And after thei daunced and commoned together, as the fashion of the maske is, thei took their leaue and departed, and so did the quene and all the ladies."

MASS, *mass* (Germ. *masse*), the quantity of matter which a body contains, upon the supposition that differences of weight are always the consequence of different quantities of matter. The mass is directly as the volume of the body multiplied into its density. The weight is constituted by the mass multiplied into the constant force of gravity. (*See* MECHANICS.)

MASS, *mass* (Lat. *missa*, sent), is the office or prayers used in the Roman Catholic and Greek churches in the celebration of the Eucharist, or in the consecration of the sacramental bread and wine into the body and blood of Christ. Some derive the term from the Hebrew *missah*, an oblation or sacrifice; others from the Latin *missa*, because, in the early ages of the Church, the catechumens, or new converts, were sent away before the consecration of the host. The prayers of the mass are all in Latin in the Roman Catholic church, and in ancient Greek in the Greek church. Mass is performed entirely by the officiating priest, standing before the altar, and attended by a clerk who says the responses. The mass is divided into four parts:—1. The preparation, or the prayers made before the offering, which was formerly called the mass of the catechumens; 2. the consecration, in which the priest consecrates the bread and wine, repeating the words "Hoc est corpus meum," &c., and then shows the people the bread and the cup, upon which all the congregation kneel down; 3. the breaking of the host and communion; 4. the post-communion, or thanksgiving, when the priest blesses the people. There are different kinds of masses. A high or solemn mass is celebrated by a priest or prelate, attended by a deacon and subdeacon, and is sung by choristers, accompanied by the organ and other musical instruments; but the principal mass on Sundays and festivals is also called high mass, though there are neither deacons, subdeacons, nor choristers present. A low or ordinary mass is one in which no part is sung, and at which the priest has no assistant but his clerk. The ordinary duration of a low mass is half an hour; the high mass is a long and pompous service. Every member of the Roman church is bound, under pain of mortal sin, by one of the precepts of the Church, to attend mass every Sunday, and on certain holidays called days of obligation, unless prevented by sickness or other grave impediment. In every parish church mass is said daily, and the priest must not break his fast from the previous midnight until he has said mass. The officiating priest is dressed in various-coloured garments, according to the festival or ecclesiastical season of the year. The following explanation of the mass and its attendant ceremonies is taken from Picart's "Religious Ceremonies:"—1. The priest goes to the altar, in reference to our Lord's retreat with his apostles to the Garden of Olives.—2. Before he begins mass, he says a pre-

paratory prayer; he is then to look upon himself as one abandoned of God, and driven out of Paradise for the sin of Adam.—3. The priest makes confession for himself and for the people; in which it is required that he be free from mortal and venial sin.—4. The priest kisses the altar as a token of our reconciliation with God, and our Lord's being betrayed with a kiss.—5. The priest now goes to the opposite side of the altar, and purifies or perfumes it with incense. Jesus Christ is now supposed to be taken and bound.—6. The introit is said or sung, applicable to the circumstances of our Lord's being taken before Caiphas.—7. The priest says the "Kyrie eleison" (Lord, have mercy upon us), in allusion to Peter's denying our Lord thrice.—8. The priest turning towards the altar says, "Dominus vobiscum," the people returning the salutation by "et cum spiritu tuo," and this means Christ looking at Peter. —9. The priest reads the epistle relative to Jesus being accused before Pilate.—10. The priest bowing before the altar says "Munda cor," and the devotion is directed to our Saviour's being brought before Pilate and making no reply.—11. The priest reads the Gospel in which Christ is sent from Herod to Pilate; and the Gospel is carried from the right of the altar to the left, to denote the offering of it to the Gentiles after it had been refused by the Jews.—12. The priest uncovers the chalice, and this means the stripping of our Lord in order to be scourged.—13. The oblation of the Host; the priest then kisses the altar and offers up the Host to represent the scourging of Christ.—14. The priest elevates the chalice and then covers; this means the crowning with thorns.—15. The priest washes his fingers as Pilate washed his hands; declares Jesus innocent, blesses the bread and wine, blesses the frankincense, and perfumes the bread and wine, &c.

MASSICOT, *mäs'-se-kot* (Fr.), in Chem., protoxide of lead, prepared by the oxidation of the metal in a current of air at a temperature below that necessary for the fusion of the oxide. It is a yellow powder, much used as a pigment.

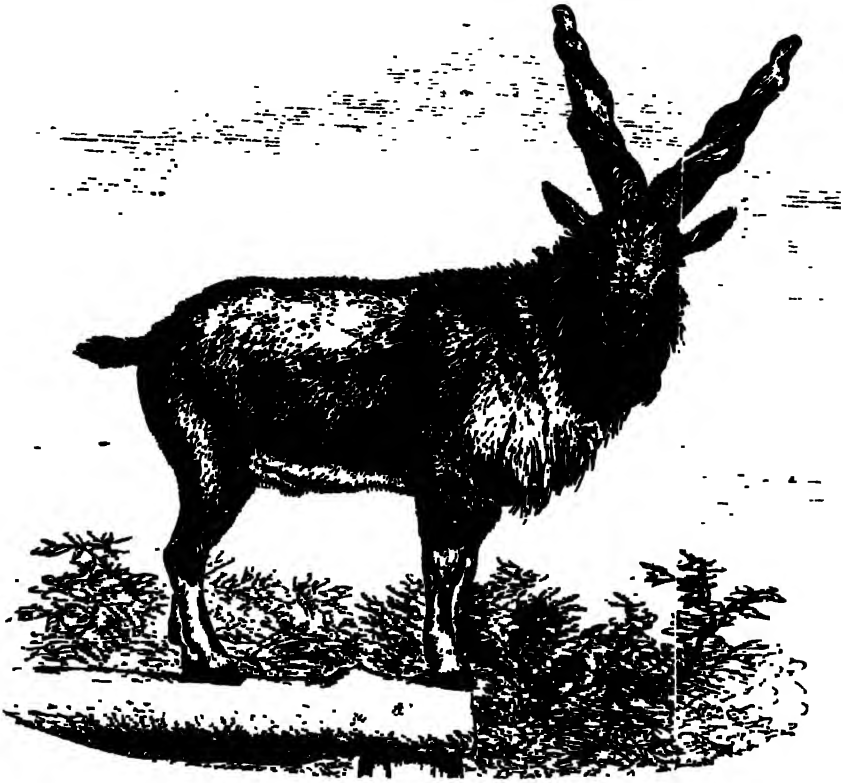
MAST, *mast* (Sax. *mast*), a long piece of timber, composed either of one continuous pole, or of a series of such, and placed nearly perpendicularly to the keel of a ship, extending upwards above the surface of the deck, for the purpose of supporting the yards and sails of a ship. The trunk of the mast is called the *lower mast*, the next piece the *topmast*, the third the *top-gallant mast*, and should there be a fourth, as there is barques and full-rigged ships, it is called the *royal mast*. Each mast is supported on the one next below it by means of cheeks placed a little below the head; on these cheeks are placed, horizontally, two short pieces of wood, fore and aft, called *trestle-trees*, and across them are the *cross-trees*, while on the masthead is a *cap*. The topmast is then raised perpendicularly along the mainmast below the trestle-trees, and through the foremast-hole in the cap; and when the *heel* of the mast is nearly on a level with the cross trees, a piece of i bolt, called a *fid*, is pushed through a hole the same; and on the fid, whose ends are supported on the trestle-trees, the topmast rests. When the mast is to be taken down, it is first raised, in order to pull out the fid, and then it can be lowered to the deck. The supports of the masts of a ship are strong ropes, extending on each side, and also forward and aft. The one leading forward is called the *stay*, and those aft are termed respectively *backstays*; while the side supports are called either *shrouds* or *breast-stays*. The *mizen-mast* is that which is nearest the stern of a ship; the *mainmast* is the centre one; and the *foremast* is nearest the bows. Of these, the main is the largest, the foremast the next in size, and the mizen the smallest. The length of the lower mainmast, according to the old rule on the subject, ought to be one-half of the sum of the breadth and length of the ship, and the other mast to be on a reciprocal scale, but as the rule is merely for purposes of convenience, more than practical principles, it is not often followed. Masts in the present day, for ships of the navy, and indeed for many mercantile vessels, are constructed of iron, on a tubular plan, and on the same scale as those last mentioned. An excellent paper, detailing the most improved modes of constructing iron masts and spars, has been communicated by Mr Charles Lamport in a paper read before the Institution of Naval Architects. Mr. Lamport stated that the strength and fitness of the masts and spars of a ship, for the service they had to perform, were elements in the success of the whole sailing-machine as important as the strength and durability of the hull itself. Broadly considered, the last twenty years had not effected any important changes in the masting and sparring of vessels, except such as had arisen from the necessity to supplement the natural deficiencies of the original material—wood, or from the substitution of another material altogether—iron. The introduction of iron and steel in the place of wood, for the masts and spars of ships, has opened the whole question to reconsideration. In designing an iron mast, the first and most obvious point was to determine the nature and degree of the strain it had to bear, along with the exigencies of its form and application; the second was to arrange the material in quantity and shape so as most effectually to meet that strain; and the third was to modify the relation of the two to the extent that the exigencies of their application would allow to suit the capabilities of the new material. In reference to the first of these two heads, the author showed that the normal strain which the mast has to bear is brought upon it as upon a column. Unsupported by the shrouds, no mast can uphold its own weight against the violent motions of a ship at sea. To design an iron mast with a view to resist the maximum transverse strain brought on it, would be a waste of material. The object should be to answer the demands upon its strength as a column consistent with lightness, absence of bulk, ease of maintenance and repair, and a provision for cutting away. To secure these we must give up the idea of taper spars and of tall masts "bending like a fishing-rod," and imitate rather the human spine, the vertebrate articulations of which, upheld by muscular supports, combine at once columnar strength with easy motion. The mast should not taper, because every particle should be brought as nearly as possible into the direct line of the strain applied, otherwise there will be a tendency to "buckling." The usual plan of wedging should be abandoned with iron masts, because it converts the mast into a beam in the position least capable of resisting a transverse strain; viz., fixed at one end and loaded at the other. The lower mast, topmast, and top-gallant mast should each be rigid in itself, but yielding with an articulated flexure to the elastic spring of the shrouds and stays. The oscillation of each should be from the keel; and the author therefore applies a cast-iron foot, terminating in a ball a little flattened in the fore and aft direction, to prevent the mast twisting and widening above, to give a flat, even, but movable support to the plates of the hollow mast. The flattened ball works in a cast-iron socket or step. The author explained that this construction agreed with the experiments of Hodgkinson, and, after further reference to those experiments, and also to Dr. Fairbairn's, stated as the results of calculation that iron masts, even of ½-inch plates, when uncrippled by wedging, were superior in strength to wooden masts of ordinary dimensions. He next gave an elaborate description of various practical details of construction in reference to masts, topmasts, and yards, recommending a great variety of improvements in those details, and next proceeded to consider the support of masts, &c. The efficient support of the mast of a ship was a question of equal importance with that of the masts,—capability to maintain its portion of the duty of propulsion. Considering the masts as pillars, the measure of their support was the measure of their efficiency. The problem for solution was to apply a given amount of support most usefully under the conditions of working efficiency. Every step in its solution necessitated a compromise. The masts had to be supported laterally, as well as fore and aft. It would be easy by "spreading" the rigging to give a more direct support against the forward pressure of the wind; but what was gained in this direction was lost in the power to withhold the mast against the side pressure. Again, the more complete the support, the more rigid became the system of masts and yards, to the loss of a certain storage equalization of force ·bed and given out by their elastic play. That spring and consequent momentum should depend upon the elasticity of the shrouds entirely. If they adopt

wire rigging, they must sacrifice more or less of this advantage. They made a compromise between the lightness and less resistance presented by it to air "on a wind," and the play and momentum of the whole system. He advocated the separate attachment of each pair of shrouds at points varying from the cap at the masthead to the truss-hoop of the lower yard. Further, he proposed to combine the advantages of both hemp and wire rigging by the use of the former for the two aftermost shrouds, and of the latter for those whose sustaining power came into play. In conclusion he said that if proof be deemed indispensable for the anchors and chains of ships, why should the masts and spars be passed over without tests? The one class of appliances was as indispensable to the safety of a ship as the other. He thought that a few preliminary experiments, instituted under proper superintendence, with a rule that all variations should be satisfactorily "proved," would very soon supply an amount of information on this subject which would be as interesting as it might prove beneficial to every branch of the shipping interest. Mr. Edward Deane has invented a mast of steel, which is an improvement upon that in use by the Government. An account of the invention is given in the *Mechanics' Magazine*, vol. xvii., from which we borrow the following description. Mr. Deane, having experimented upon the subject for two years, at length produced a form of mast which offers very great advantages. Mr. Deane uses steel in the construction of his masts. The mast consists of an outer skin, formed of four plates, held together in the centre by angle-irons riveted on. The outer edges of the stiffening plates are held between the flanges of the outer skin. The practical value of this form of construction has been made evident by a series of carefully conducted experiments. Mr. Deane's mast was tried against another made of Bessemer steel of similar weight and make. The power required to break the Bessemer mast was about a quarter of a ton more than that which fractured the Deane steel mast. But then other considerations had to be borne in mind. One point, and the most important, was the extent to which the element of safety was actually present. In the trials it was manifest that there was greater absolute safety in the Deane than in the Bessemer steel. In the case of the Bessemer mast the first fracture was accompanied by a loud sharp report, which indicated that the mast was absolutely destroyed. With the Deane steel the reverse order was observed: the first crack was indicated by a slight report, which, as pressure increased in amount, so the noise of the fracture increased in loudness, until the last sharp report, when all was over. The valuable facts to be gathered from these circumstances—which speak highly for the Deane steel—are that a mast of Bessemer steel would give way, and be destroyed at once, on the breaking strain being reached, whilst a mast of Deane steel would give way gradually, and would still have an amount of work left in it after the first fracture, which the Bessemer would not. Of course in all structures there is an ample margin of safety left, and provision is made for a higher strain than the material will ever have to bear in its ordinary work. An examination of the two masts after testing showed most clearly the superior tenacity of the Deane steel. In the Bessemer sample the point at which the pressure was brought on, and which, of course, was in comparison, was well crumpled up; but it had a ribbon-like appearance, and there was no fracture, no separation of the fibre, as in the Bessemer sample. This is a most important fact, and one accounting for the gradual destruction of the Deane sample as against the sudden demolition of the Bessemer mast. It is therefore clear that the Deane steel mast is superior to that made by the Bessemer mode, notwithstanding that the breaking strain was less than that of the latter. The difference between the two was, however, but very slight, only a quarter of a ton on twenty-four tons, which practically goes for very little; the more so that only one experiment was tried with each. Thus the Deane may be considered the best steel mast we yet possess.—*Ref. Mechanics' Mag.*

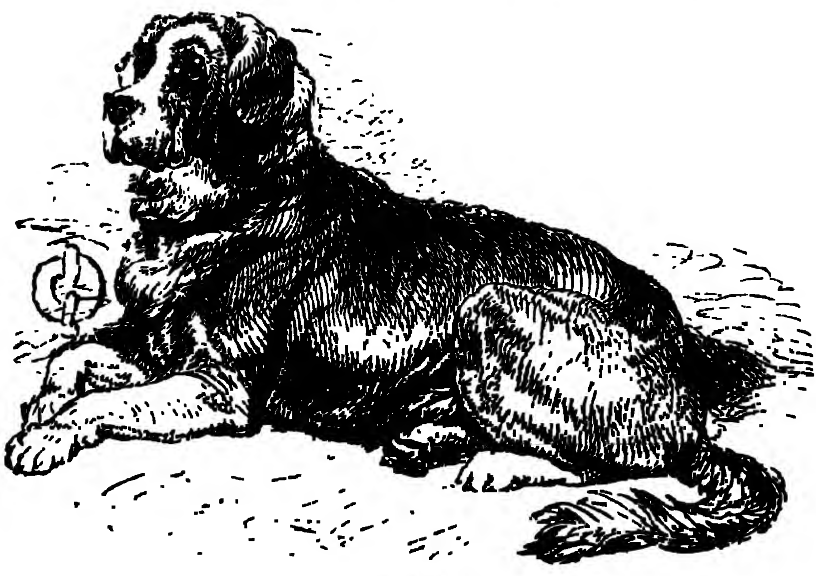
MASTER, *mast'-er* (Lat. *magister*), denotes, in a general sense, the governor, director, or owner of a thing; also one skilled in any particular pursuit of science; it is also sometimes used as a title of honour. Among the ancient Romans, *magister*, with some qualifying word or phrase, was used as a title of honour; as *magister equitum*, master of the cavalry, who held the first rank in the army after the dictator.—Master of arts (*magister artium*) is a degree conferred by the philosophical faculty of a university, being the first degree taken in foreign universities, as well as in those of Scotland, but the second in those of Cambridge and Oxford. (*See* DEGREE.)—Master of the ceremonies, an officer instituted by James I. for the more solemn and honourable reception of ambassadors and other strangers of quality to be introduced into the royal presence.—Master of the household is an officer of the royal household under the lord steward, whose duties are chiefly the selection and superintendence of the servants, and examining certain of the accounts.—The master of the horse has the government and direction of the royal stables; and the master of the buckhounds attends at and controls the royal hunts.—The master of the Mint and his deputy are the ostensible executive heads of that department under the Treasury.—Masters in chancery were assistants to the lord-chancellor, usually twelve in number; but these offices were abolished by 15 & 16 Vict. c. 80.—Master in lunacy. (*See* LUNACY.)—The Master of the rolls is the assistant of the lord-chancellor in chancery. He has the keeping of the rolls and grants which pass the great seal and the records of chancery. He administers equity in the Rolls court, having certain causes assigned to him to hear and decree; but his judgments require to be signed by the lord chancellor.

MASTER, in Commercial Navigation, is the person intrusted with the care and navigation of a ship. He is the confidential servant of the owners, who are bound to the performance of every lawful contract entered into by him relative to the usual employment of the vessel. The master has power to pledge both ship and cargo for repairs executed in foreign parts, but not for repairs executed at home. The Mercantile Marine Act, 13 & 14 Vict. c. 93, authorized the Board of Trade to establish local marine boards in ports having 30,000 tons or upwards of ships trading to foreign ports. These boards were empowered to examine all candidates for the situation of masters and mates who came before them, and to grant "certificates of competency" to such as they found qualified. Under the provisions of the Merchant Shipping Act of 1854 (17 & 18 Vict. c. 104), it is declared that no foreign-going ship or home-trade passenger-ship can obtain a clearance or transire, or legally proceed to sea from any port of the United Kingdom, unless the master thereof, and, in the case of a foreign-going ship, the first and second mates, or only mate (as the case may be), and, in the case of a home-trade passenger-ship, the first or only mate (as the case may be), have obtained and possess valid certificates either of competency or service appropriate to their several stations in such ship, or of a higher grade; and no such ship, if of 100 tons burden or upwards, can legally proceed to sea, unless at least one officer besides the master has obtained and possesses a valid certificate appropriate to the grade of only mate therein or to a higher grade. A master must be twenty-one years of age, and have been six years at sea, of which one year must have been as first or only mate, and one year as second mate, or two years as first and only mate. The master is examined as to his knowledge of the various subjects connected with navigation, the laws of tides; the nature of attraction of the ship's iron upon the compass; the management of his crew; construction of rafts; his knowledge of charter-party, invoices, bottomry, &c.—*Ref.* McCulloch's *Commercial Dictionary; The Mercantile Navy List.*

MASTER AND SERVANT, in Law, is a certain relationship, constituted by mutual consent, whereby a person calls in the assistance of others, where his own skill and labour are not sufficient to carry out his own business or purpose. Such arrangements are subject to the laws that govern ordinary contracts, must be entered into voluntarily and by persons qualified to give their consent. The law will not regard the most formal contract, if it appear to have been extorted by force or fear, or obtained by fraud. The existence of the contract may be proved by writing or, within certain



MARKHOOR, OR GREAT HORNED GOAT.



MASTIFF.

limits, by witnesses; and it may sometimes be inferred from circumstances. The duties to be performed, the recompense for those duties, and the duration of the contract, are matters of arrangement; or they may be guided by custom; but no custom will prevail against express stipulation. A master or mistress is not legally bound to give a character; but if a good character be given to an undeserving servant, the person giving such character is liable to action by the new master, and if the servant has been guilty of robbery, will have to compensate for the loss. If a bad character be untruly and maliciously given, the person giving it will be liable to an action for defamation, though both the truth and the malice require to be proved. In general, a master is liable, civilly and sometimes criminally, for wrongs committed by his servants in the course of or under colour of his employ; but he is not answerable for the wilful misfeasance of his servant, who has wholly lost sight of his duty. There are two classes of servants,—those who receive wages, and apprentices. The contract for service in the two cases is quite different: in each, the servant is bound to render service; but in one the master is bound to pay the stipulated wages, in the other to give instruction. Apprentices are usually bound for a term of years by deeds indented, or indentures, to serve their masters, and be maintained and instructed by them. (*See* APPRENTICE.) Of servants who receive wages, there are several kinds. Menial or domestic servants are generally engaged at a fixed amount of wages per annum; but there is generally no express stipulation as to the time the service is to last; and when the terms are not otherwise defined, it is generally understood that either party may terminate the service upon a month's warning, or upon payment of a month's wages. Clerks, tutors, governesses, &c., though in a sense menial (*intra mœnia*), cannot, like common domestics, be turned off at a month's notice, if there be no stipulation to that effect; for such a one is understood to be engaged by the year (at least if the wages or salary be payable by the year or quarter). If a yearly servant be dismissed before the year expires, for misconduct which will justify his dismissal, he is not entitled to wages even for that part of the time which he has served. Labourers, i.e. servants in husbandry or manufactures, not living *intra mœnia*, th[illegible] sometimes engaged by the day or week, are [illegible] to be hired for a year, where no particul[illegible] mentioned, and the wages are so much per annum. Various acts of parliament have been passed regulating the hours of work, &c., of certain classes of labourers, and also empowering justices to determine differences arising between such labourers and their masters. A master cannot, by way of correction, even moderately beat his servant or labourer in husbandry, or otherwise, as he m[illegible]ght his child or apprentice; and if he d[o] so, the servant may [illegible] depart or obtain his discharge [illegible] to a justice, and support an action for battery. An exception is made with regard to soldiers and sailors, from the necessity of larger powers to preserve discipline and prevent mutiny.—*Ref.* Burn's *Justice*, art. Servants.

MASTER-SINGERS, or MEISTERSÄNGER. (*See* GERMAN LANGUAGE AND LITERATURE.)

MASTIFF, *mas'-tif* (*Canis molossus*), one of the noblest, as well as the most powerful, varieties of the canine family. The mastiff is distinguished by a large head, with a broad muzzle to match, ears of moderate size and dependent, a heavy brow, thick drooping lips, and a well-proportioned strong body, and a full tail. The strength of the mastiff is immense, and its vigilance and faithfulness as a house-dog and guard are unrivalled. In Jesse's "Anecdotes of Dogs" there are many stories related of the mastiff, which exhibit its character in very favourable lights. The following is amply corroborated. A baronet of Oxfordshire had a large mastiff which guarded the premises, but which was never shown any kindness or attention beyond being retained for his fidelity. One night, as this gentleman was going to bed, attended by his valet, an Italian, the mastiff silently followed them upstairs, and tried to gain admittance into the baronet's chamber. At first this was refused; but on the animal's continuing to make a noise at the door, it was admitted, and suffered to lie down on the floor. At midnight the chamber-door opened, and the mastiff sprung up with a growl, and fixed on the intruder, holding him firmly until a light could be brought, when the person was found out to be the Italian valet, who confessed that it was his intention to murder his master and rob the house. It is really wonderful what presentiments of approaching danger these animals have, on account of their close observation and watchful jealousy.

MASTODON, *mås'-to-don* (Gr. *mastos*, a nipple; *odous*, a tooth), the name given by Cuvier to a genus of extinct fossil quadrupeds, allied to the elephant, so called from certain remarkable mamillary processes on the teeth. The remains of the mastodon are found associated with those of the mammoth in the tertiary beds of England. A species of mastodon, however, larger than that found in Europe, has been found in many parts of North America. A specimen of the animal, nearly perfect, was obtained in the state of Missouri in 1840. It was exhibited at the Egyptian Hall, Piccadilly, London, in 1842 and 1843. It was greatly distorted; but having been purchased by the trustees of the British Museum, it was made to assume its natural proportions, and now forms an attractive feature in the portion of that building devoted to palæontology. Its proportions are as follows:—Extreme length, 20 feet 2 inches; height, 9 feet 6½ inches; cranium, length, 3½ feet; width, 2 feet 11 inches; tusks, extreme length, 7 feet 2 inches; circumference at the base, 27 inches. The remains were found imbedded in a brown sandy deposit, full of vegetable matter, with recognizable remains of the cypress, tropical cane, swamp moss, stems of the palmetto, &c.; and this was covered with beds of blue clay and gravel to a thickness of about fifteen feet. Indian flint arrow-heads were also found about and under the bones of the skeleton.

MATADOR. (*See* BULL-FIGHTS.)

MATE, *mait* (Du. *maat*, a companion), in the Commercial Marine, the designation applied to the deputy, or next in command to the captain; there being *first*, *second*, and *third mates*. In men-of-war there used to be a grade of officers ranked between the lieutenants and midshipmen, styled mates; but, in the present day, the term has given place to the appellation *sub-[illegible]*. There are, however, still *master's mates*, [illegible] *mates*, and *boatswain's mates*, which are the [illegible] of those officers selected from the crew.

MATERIALISM, *må te'-re-ål-izm*, in Phil., is commonly used to characterize such systems as deny the existence of a spiritual or immaterial principle in man apart from matter. From the loose and general way in which the term is used, it embraces systems that differ widely from each other. A very modified system of materialism, if, indeed it ought to be called materialism at all, is one which, while admitting the existence of a soul, attempts to account for the various mental phenomena by physical causes. Then there is what we may term the materialism of Dr. Priestley, which denies the existence of a soul in man capable of surviving the body, but yet believes in the resurrection of the body and a future state of rewards and punishment. Again, there are those materialists who deny the existence of anything in this world but matter, and consequently do not believe in the existence of Deity, or in a future state. The last of these are strictly and purely atheists. (*See* ATHEISM.) Dr. Priestley has more clearly and fully than any other person expounded the principles of materialism in the pure and proper sense of the word. He denies the existence of an immaterial principle in man, because he thinks that it could not exist in union with a material body; and because he thinks that all the mental phenomena may be explained by "medullary vibrations," and other supposed movements of the material parts. The corporeal and mental faculties are inherent in the same substance; grow, ripen, and decay together; and whenever the system is dissolved, it continues in a state of dissolution till it shall please the Almighty Being, who called it into existence, to restore it to life again. In this view the question of materialism is not, perhaps, of so much consequence as some may imagine. Its advocates deny that their doctrine militates against the hope of a resurrection; on the contrary, they maintain that it points out "more fully the necessity and value of a

resurrection from the dead," on which alone they say that the sacred writers build all their hope of a future life; for the apostle Paul says "If the dead rise not, then is not Christ risen," &c. (1 Cor. xv. 16). These views were at one time held by Robert Hall, though he afterwards saw reason to change them. Materialism almost of necessity involves the doctrines of [illegible]ism and philosophical necessity. The great objection to it is that it is unphilosophical. It rests entirely upon hypotheses and conjecture. We have no evidence for the assertion of Mr. Lawrence, that "medullary matter thinks." Much as it is known that mind depends upon matter for its development in man, every property of mind and every property observable in matter are so essentially different, that the idea of homogeneity in the two substances is too extravagant to be admitted except on much stronger evidence than materialists have yet been able to bring forward. Until it can be inductively established that the modes of *extension* and the modes of *thought* are alike ultimately referrable to one common substance, the laws of a sound philosophy demand the ascription of the one class of phenomena to one substance, termed matter, and of the other class of phenomena to another substance, termed mind. Much mischief is often done to philosophy by mixing up the results of observation with what can only be matter of conjecture. The true philosopher, setting aside all speculation regarding the ultimate nature of matter or spirit, will set out from these as fixed principles, and apply himself to observing their qualities, capabilities, and laws. —*Ref.* Priestley's *Disquisitions on Matter and Spirit*, and his *The Dissertations on the Doctrine of Mater*[illegible] *and Philosophical Necessity*, Price's *Letters* [illegible] *Materialism and Philosophical Necessity*.

MATERIALS, STRENGTH OF, *ma-te'-re-al.* (Fr. *matériel*), the power which any substance, such as a rod, bar, beam, rope, or chain, possesses, so as to enable it to resist any attempt made to sever the adhesion of the various parts of which it is composed. The strength of materials consequently depends, in the first place, on the relative disposition of the particles of the substance to each other; secondly, on the intensity of the force by which the particles adhere to each other; and, lastly, on the manner in which the straining power is applied. The relative properties of a beam between its strength and the strain to which it is subjected, can only be made the subject of mathematical investigation by supposing the material to consist of an infinite number of threads, or fibres, arranged in lines parallel to each other in the direction of its length. These part[illegible] must also be supposed to cohere together [illegible] powers exerted in that direction, and also to cohere laterally by powers which may be either equal or unequal to the powers that act along its length. In glass, and some metals,—in fact in the generality of homogeneous bodies, the particles are disposed of symmetrically through the substance, and attract each in every direction with equal force. In timber, however, the lateral cohesion of the particles is less than the longitudinal cohesion of the various particles in each fibre. In trying, therefore, the load which a piece of timber will sustain, we must first find out the weight that will suffice to break it, and anything less than that will be the weight which it can bear. The stiffness of a beam is the proportion that exists between its deflection and its length, and the deflection is the extent to which it sinks, when loaded, below a horizontal line. The deflection of beams of the same timber similarly loaded varies as the weight applied and the cube of the length directly, and as the breadth and cube of the depth inversely, and this deflection, according to an eminent authority on the subject, should never be permitted to extend beyond $\frac{1}{480}$ part of the length, or $\frac{1}{40}$ part of an inch to the foot. The lateral strength of a beam is less than its absolute longitudinal strength, either against compression or extension, from the causes stated above with regard to the cohesion of the particles. Timber will bear considerable weight if it is suspended to it perpendicularly, or when pressing in the direction of its length, provided the timber is prevented from bending and, therefore, in using timber, a lateral strain should be avoided where a longitudinal one can be substituted. The fibres of ropes have no lateral cohesion, and the strength must necessarily depend on the twisting of the fibres together, and the cohesion of all the particles in any transverse section must be destroyed before a disruption can take place. In an article in the "Penny Cyclopædia," the writer observes, that in a rod of any material consisting of parallel fibres as supposed above, being placed in a vertical position and strained by a weight applied at the lower extremity, the particles in every fibre will be separated from each other by the action of the weight, and consequently, its length will be increased. The cohesive power by which the particles are kept together will, in most cases, be lessened by the separation; and if the weight be heavy enough, or if it be allowed to act long enough, the cohesive power will be altogether overcome; that is to say, the rod will be torn asunder in some part or other. The elongation of a rod, when strained by a weight, and the amount of the weight necessary to produce fracture will, of course, depend considerably on the nature of the material. The following is a table of breaking weights in pounds avoirdupois, taking the area of a transverse section of each rod to be one square inch:—English oak, 8,000 to 12,000 lbs.; fir, 11,000 to 13,488; beech, 11,500; mahogany, 8,000; teak, 15,000; cast steel, 134,256; iron wire, 93,964, Swedish bar-iron, 72,064; best English malleable iron, 60,000, cast iron, 13,656 to 19,488; wrought copper, 33,792, platinum wire, 52,987, silver wire, 38,257, gold wire, 30,888, zinc wire, 22,551, tin wire, 7,129, lead wire, 3,146; and rope of one inch circumference, 1,000 to 12,566. A piece of timber has been proved to be of the greatest strength when cut out of a round tree, by dividing the diameter into three equal parts, raising perpendiculars upon them, and prolonging them until they cut the circumference; a rectangle uniting these points shows the form of the strongest beam that can be obtained. The strain upon a beam fixed at one end in a wall, and loaded at the other, is four times greater than when the same weight is hung upon the middle of the same beam, and the latter is supported at both extremities. When a beam is fixed at both its extremities, and is loaded in the middle, its strength is to that when only supported at its two ends as 3 to 2, and when a weight is uniformly distributed over a beam, its mechanical action to produce fracture is only one-half of what it is when collected in the middle. If a body is compressed in a direction perpendicular to the length of the fibres, the points of support being very near together, and on opposite sides of the place at which the force is applied, the strain to which the body is subjected has been called the force of detorsion. A writer in the "English Cy[illegible]" observes that "such machines as cap[illegible]lasses, and axles, which revolve with their wheels, are, when in action, subject to be twisted; so that their fibres tend to become curved in oblique directions; and the strain thus produced is called that of torsion. The most natural way of investigating the strength to resist this kind of strain is probably that which was adopted by Dr. Robison. This mechanician imagined the cylindrical body to be composed of an infinite number of concentric hollow cylinders inserted in each other, and, supposing the whole to be cut by a plane perpendicular to the axis, he conceived that two particles in the circumference of any one of the concentric circles would resist the effort to separate them by a force proportioned to their distance from the common axis." Some useful tables with regard to the different resistances made by various substances to efforts of compression and extension will be found given in Wallis's edition of Barlow's *Materials and Construction*; Carr's *Synopsis of Practical Philosophy*; Cressy's *Encyclopædia of Civil Engineering*, and in many other useful works, particularly in Claudel's *Formules à l'Usage des Ingénieurs*. *See* also article on MECHANICS.

MATERIA MEDICA, *mă-te'-re-ă med'-e-kă* (Lat.), a general name for the substances and agents which are employed for the relief or cure of disease. The term is also applied to that branch of study which elucidates the nature and properties of such substances and agents. In medical schools it is customary to connect Materia Medica with Therapeutics, and to expound both departments of science in one course of lectures. Therapeutics may be described as that branch of study which treats of the application of the Materia Medica for the prevention and cure of the various diseases.

These allied branches of professional study are of the utmost importance; for before a thorough knowledge of the nature and action of medicines is obtained, it is impossible to know how and when to prescribe them. Medicines have been defined as "all substances which have the power of modifying the actual state of one or more of our organs, and which possess this property independent of their nutritive qualities." It is not easy to define medicines or remedies as distinct from poisons, for there are many substances that act either as remedies or poisons according to the quantities in which they are applied to our organs. The Materia Medica may be classified in two ways; the first being according to their natural history, and the second according to their physiological and therapeutic effects. In the natural history arrangement, remedies obtained from the inorganic kingdom (mineral and chemical substances) form the first class; remedies yielded by the vegetable kingdom (herbs, fruits, roots, leaves, principles separated from plants, &c.) form the second class; and remedies yielded by the [illegible]al kingdom (insects, fats, animal secretions, &c.) form the third class. Many classifications, based upon the effects of remedies, have been proposed; but they are all more or less imperfect, [illegible] dies prod[illegible] different effects, and m[illegible] diseases are curable by different modes of treatme[illegible] The arrangement adopted by Dr. Royle, in his e[illegible]llent "Manual of Materia Medica and Therapeutic[illegible] comprehends the principal features of all the best schemes of classification. The divisions of this arrangement are shown in the following table.—

A.—Mechanical Remedies.

Diluents, Demulcents, Emollients.

B.—Chemical Remedies.

Escharotics, Acids, Alkalies, Antilithics, Disinfectants, Astringents, Antidotes.

C.—Vital Agents.

1. *Evacuants or Local Stimulants.*

Alteratives, Errhines, Sialogogues, Emetics, Expectorants, Diaphoretics, Diuretics, Cathartics, Anthelmintics, Emmenagogues, Rubefacients.

2. *General Stimulants.*

Tonics, Stimulants, and Aromatics. Diffusible and Special Stimulants.

3. *Depressants, or Contra-Stimulants.*

Narcotics, Antispasmodics, Refrigerants, Sedatives.

The groups of medicinal agents ranged under the head of "Mechanical Remedies" are supposed to act only [illegible] or by their simple mechanical propert[illegible] *D[illegible]* are remedies which are supposed to increase the fluidity of the blood: their general effect is to allay thirst and to diminish the heat of the skin; to promote transpiration from the skin, as well as to increase the flow of urine. *Demulcents* and *Emollients* are substances which are calculated to soften and lubricate the parts to which they are applied. The former term is restricted to such as are intended f[illegible] internal exhibition, and the latter to [illegible]ch [illegible] tended for external application: thus, arrowroot, calves'-feet jelly, and liquorice, are demulcents, while liniments, embrocations, and cataplasms, are emollients. Under the head of "Chemical Remedies" are placed those agents which seem to act chiefly by producing chemical changes in the solids or fluids of the body. *Escharotics*, usually called *caustics*, are substances employed for destroying the vitality of the part to which they are applied. *Acids* and *Alkalies* act upon the secretions as they act upon substances out of the body, and respectively counteract alkalinity and acidity. *Antilithics* are medicines which counteract the tendency to the deposition of urinary sediments or calculi. *Disinfectants* are substances suited to free t[illegible] air of buildings, and infected bodies in general, of the invisible particles which propagate disease; while *Antiseptics* are those chemical agents which prevent the decomposition of organic structures, whether vegetable or animal. *Astringents* are remedies which have the power of corrugating, or of producing a contraction, of the muscular fibres of the part to which they are applied, as well as of coagulating or precipitating albuminous fluids. *Antidotes* are agents which counteract the effects of poisons. The division "Vital Agents" includes those groups of medicines which are considered to act in a more special manner upon the living structures,—upon the muscular, sanguineous, and secerning systems, and all as dependent upon the nervous system. The groups placed in the first subdivision, *Evacuants*, cause increased secretion or evacuation from the different organs. *Alteratives*, according to the usual interpretation of the term, are remedies which, when taken in comparatively small doses, and continued for some time, by degrees, and almost without any perceptible effect, produce changes in the secretions and in disordered actions. *Errhines* are medicines which are applied to the mucous membrane of the nostrils: those which cause sneezing are sometimes distinguished by the term *Sternutatories*. *Sialogogues* are medicinal agents which increase the secretion of saliva; *Emetics*, those which evacuate the stomach by vomiting; *Expectorants*, those which favour the expulsion or secretion of mucus from the organs within the chest; and *Diaphoretics*, those which increase exhalation from the surface, and the natural function of perspiration: to the latter, when acting so as to produce sweating, the term *Sudorifics* is applied. *Diuretics* are medicines which are considered to have the power of augmenting the secretion of urine; *Cathartics* increase the peristaltic movements of the intestinal canal, evacuate its contents, and usually augment its mucous secretions. These were formerly divided into *Hydragogues*, causing watery evacuations, and *Cholagogues*, favouring the secretion of bile. Cathartics are also often distinguished according to their energy of action, as *Laxatives*, which merely evacuate the intestinal contents, and *Purgatives*, which stimulate secretion and accelerate evacuation. The more violent purgatives are further distinguished as *Drastics* and *Hydragogue Cathartics*. *Anthelmintics* are medicines which are prescribed against the production of worms, also to destroy or prevent them. Those which destroy or expel worms are also termed *Vermifuges*. *Emmenagogues* are medicines which are considered to have the power of promoting the menstrual discharge, when either retained or suspended. *Rubefacients*, as their name indicates, produce redness of the skin, with warmth and increased sensibility. These are also known as *Counter-irritants*, and when concentrated, as *Epispastics*, or *Vesicants*. The second subdivision, *General Stimulants*, includes those remedies which excite all the principal functions of life, by directly influencing the nervous system. *Tonics* are those which [illegible]ess the power of gradually increasing the tone of [illegible] muscular fibre when relaxed, and the vigour of the body when weakened by disease. *Stimulants* or *Excitants* are medicines which exalt nervous power; *Aromatics* are those stimulants which are grateful in odour [illegible]nd taste, as the spices, &c.; and *Diffusible stimulants* those which excite the whole system with great rapidity through the medium of the brain. Of the latter group, alcohol and ether are examples. The subdivision *Depressants* includes those medicines which are employed to subdue inordinate action; the *Narcotics*, which, by acting on the brain or spinal marrow, assuage pain, control restlessness, and procure sleep; the *Antispasmodics*, which allay the irregular muscular contractions called spasms; the *Refrigerants*, which diminish the force of the circulation, and so reduce the heat of the body; and the *Sedatives*, which directly and primarily depress the powers of life without previously exciting nervous action or increasing the circulation.—For particulars respecting the substances employed as medicines, the reader is referred to the botanical and chemical articles of the Dictionary; also to Dr. Royle's *Manual*, mentioned above.

Mathematics, *math-e-mat'-iks* (from Gr. *mathesis*, learning), a term applied to that science which investigates the consequences which are logically deducible from any given or admitted relations between magnitudes or numbers, without being descriptive of their subject matter. Mathematics are divided into two classes; namely, *pure* and *mixed*. Pure mathematics embrace such subjects where magnitude is only considered in the abstract. From the fact of this branch being founded on the simplest notions of quantity, the conclusions which are deduced from it have the same evidence and certainty as the elementary principles from which they are obtained. Pure mathematics

consequently comprehend *Arithmetic*, treating on the properties of numbers; *Geometry*, treating of extension as dependent on the three qualities of length, breadth, and thickness, without considering any physical qualities with which bodies may be endowed; *Algebra*, which compares together all quantities, whatever may be their value; and, lastly, the *Differential* and *Integral Calculus*, which operations consider magnitudes as of two kinds,—constant and variable; the variable magnitudes being generated by motion, the operations of the calculus being to determine the values of these quantities from the velocities of the motions with which they are generated. On the other hand, *mixed mathematics* consider the application of *pure mathematics* to certain established physical principles; and this branch comprehends all the mathematical sciences which appertain to physics; as *mechanics*, *hydrodynamics*, *optics*, *a... ...y*, *acoustics*, *electricity*, and *magnetism*. A writer in the "English Cyclopædia" observes, "The unavoidable certainty and definite character of mathematical conclusions have obtained for mathematics the name of *exact science*, but to this name it has not exclusive right. The laws under which we must think are the foundation of a science which has an equal claim with mathematics to any epithet which indicates either necessity or precision. Accordingly, logic and mathematics are separate branches of exact science. There are but three things of which we cannot divest ourselves so long as we imagine ourselves to retain both existence and consciousness of existence,— they are, thought, space, and time. With everything else there is a possibility of dispensing; that is, the imagination can con... everything got rid of and out of existence, except its own consciousness in some kind of activity, and the space and time without which it cannot conceive existence. The necessary laws of thought are the subject matter of logic; the necessary properties of space and time are the subject matter of mathematics. *Number* is an offspring of the notion of time; enumeration is a succession in time: in no other way can *number* be distinguished from *multitude*. And geometry is, without need of illustration, the offspring of the notion of space." The rise of mathematics from the days of Thales and Pythagoras will be found given under th... art. GEOMETRY, and it need not be commented upon here. Mathematical science may be either used as a discipline of the mind, or it may be applied as an instrument in the advancement of the arts and in studying the wonderful panorama of the world around us. Taken in the former point of view, the object of mathematics is to strengthen, by frequent examples, the power of logical deduction, to put forth a view of the difference between reasoning on probable premises and on certain ones, by constructing a body of results which do not involve, in any case, the uncertainty arising from the introduction of that which might have been false. Mathematics also tend to form the habit of concentrating the attention closely to difficulties which can possibly be only overcome by thought, and over which victory is certain, so that the right m... be used. As an instrument in advancing the arts and investigating the laws of nature, mathematics enable us to acquire vast knowledge; and without their aid most of the physical and other sciences would still be in a state of embryo. This knowledge, therefore, is gained by our applying abstract truths and tried formulas in order to obtain results before hidden, and, by advancing fictitious premises, to arrive at the real truth, which custom might endeavour to conceal. It would be impossible, in the present article, to enter at length upon the metaphysical discussion of the subject, as it would be alike not our purpose so to do. The various branches of mathematics, however, will be found given under their respective h... ...s, ... to those articles the reader is referred for further information. (*See* FLUXIONS, GEOMETRY, I... ...CAL CALCULUS, &c. &c.)

MATICO, *măt'-e-ko*, the name applied in South America and Mexico to leaves of certain plants employed to stop bleeding. The matico was first brought into notice as a styptic in leech-bites, w... ...s of arteries, &c., by Dr. Jeffreys, in 1839; and it is now officinal in the Dublin Pharmacopœia. Its action is probably simply mechanical, depending on the hairs which cover its under surface. It is probably useless ... an internal styptic, as which, nevertheless, it has been recommended by some writers. (*See* ARTANTHE and EUPATORIUM.)

MATRICARIA, *măt-re-kai'-re-ă*, in Bot., a gen. of the nat. ord. *Compositæ*. The species *M. Chamomilla* bears flowers which have similar properties to those of the true-chamomile plant. (*See* ANTHEMIS.)

MATTHEW, ST., GOSPEL OF, *măth'-yu*, is the first in order of the four Gospels of the New Testament, and is generally believed to have been first also in point of time; but the exact date is unknown. Opinion is divided as to whether this Gospel was originally written ... Greek or Hebrew, or whether Matthew did not write it in both languages. On the genuineness and authenticity of St. Matthew's Gospel we have the most satisfactory evidence, though there have not been wanting critics to call them in question. The Gospel of St. Matthew, as compared with the other Gospels, is characterized by the clearness and particularity with which many of our Saviour's discourses and moral instructions are related; as in the sermon on the Mount, &c. In general, it may be said that the narration of our Lord's actions is commonly made subservient to his instructions which are introduced. The style is everywhere plain and perspicuous. This Gospel was ...ently primarily written for Christians of Jewish descent in Palestine. Every circumstance is carefully pointed out which might tend to strengthen the faith of that people, and every unnecessary expression is avoided that might tend to obstruct it. Everywhere there is kept in view the evolution of the twofold title of the first verse, "son of David," "son of Abraham." This Gospel consists of four parts.—1. On the infancy of Jesus Christ (i. ii.); 2. the discourses and actions of John the Baptist preparatory to our Saviour's commencing his public ministry (iii—iv. 11); 3. the discourses and actions of Christ in Galilee, by which he demonstrated that he was the Messiah (iv. 12—xx. 16); 4. containing the transactions relative to the passion and resurrection of Christ (xx. 17—xxviii.)—*Ref.* Horne's *Introduction to the Holy Scriptures*.

MAUNDAY THURSDAY, in the Church, is the Thursday before Easter, being the day on which our Lord instituted the holy sacrament of the Eucharist. The name maunday is said to be a corruption of mandati (*dies mandati*, day of the c... ...), in allusion to the commandment which ... ...r gave on this day, after washing his disciples' feet, to love one another. Others suppose that the name is from the *maunds*, or baskets of gifts, which Christians were in the way of presenting to each other on this day in token of mutual affection. It is customary in some parts of the continent for bishops, sovereigns, and others, t... ...h th... feet of twelve poor persons on this day; and in thi... country it is still the custom for the lord almoner to ... certain royal donations to the poor in the royal chapel at Whitehall on Maunday Thurs...

MAUSOLEUM, *maw-so-le'-um*, a term applied in modern times to a sepulchral building erected for ... purpose of receiving a monument. It originally signified the sepulchre of Mausolus, king of Caria, a magnificent edifice erected by his queen Artemisia, at Halicarnassus, B.C. 353. In order to raise this splendid monument to the memory of her deceased husband, the queen employed the most eminent architects and artists of the Ionian and Attic schools. The description of the mausoleum as given by Pliny is very unsatisfactory, ...h t... the most complete which we possess. The s... ... ... building was in doubt until a few years ago, when Mr. C. T. Newton, keeper of the Greek and Roman antiquities in the British Museum, discovered its remains at Budrum, in Asia Minor. Representations having been made to the English government, an expedition was fitted out in 1856, and by ... ... excavations and examinations, the original site ... ...early made out and some very extraordinary statues and sculptures in marble obtained. According to Pliny, the original building was an oblong quadrangular *cella*, 63 feet from north to south, 411 feet in circ... ...ce, and 37½ feet in height, decorated with a ... ... 36 columns, and carried up into a pyramid surmounted by a chariot and four horses, executed ... marble by Phileus, one of the architects. In many respects Mr. Newton's measurements agree with those

given by Pliny. — Ref. *A History of Discoveries at Halicarnassus, Cnidus, and Branchidæ*, by C. T. Newton, M.A.

Maxima and Minima, *măks'-e-mă, min'-e-mă* (Lat. the *greatest* and *least*), terms employed not to signify the absolute greatest and least (as the words imply) values of a variable quantity, but the values it has at the instant when it ceases to increase and begins to decrease, or *vice versâ*. A variable quantity may, therefore, have several *maxima* and *minima*. The theory of the *maxima* and *minima* will be found given in most elementary works on the differential calculus.

May, *may* (Lat. *Maius*), the fifth month of the year, has thirty days. It was second in the old Alban calendar, third in that of Romulus, and fifth in that of Numa Pompilius. In the Alban calendar it only had twenty-six days, in the calendar of Romulus thirty-one days, and in that of Numa thirty days. The odd day of which Numa deprived it was restored by Julius Cæsar. The etymology of the word is doubtful. It was called *Maius* by Romulus, in respect to the senators and nobles of his city, who were called *Majores*, as the month following was called *Junius*, in honour of the youth of Rome, who served him in war, and were named *Juniores*. Some etymologists are of opinion that it was called *Maia* from the goddess of that name, the mother of Mercury, to whom they offered sacrifices on the first day of this month. The sun enters Gemini during May, and the plants of the earth generally begin to flower.

Mayaceæ, *may-as'-se-e*, in Bot., the *Mayaca* fam., nat. ord. of [illegible], sub-class *Petaloideæ*, consisting of a [illegible] of small moss-like plants closely allied to *Commelynaceæ*. They are found in America, from Brazil to Virginia. Their properties and uses are unknown.

May-apple. (*See* Podophyllum.)

May-day, *may'-day*, the 1st of May. From an early period it was the custom for all ranks of people to go out "a maying," as it was called, early on the 1st of May. In all parts of England, at the dawn of May-day, the lads and lasses left their towns and villages and repaired to the woodlands with music and singing. There they gathered the *may*, or blossoming branches of the trees, and bound them with wreaths of flowers. Returning home by sunrise, they decorated the lattices and doors of their dwellings with their scented spoil, and spent the rest of the day in sports and pastimes. According to Bourne, the after-part of May-day was chiefly spent in "dancing round a tall pole, which is called a Maypole, which, being placed in a convenient part of the village, stands there, as it were, consecrated to the goddess of flowers, without the least violation offered to it in the whole circle of the year." At one time, as we can see from the writings of Chaucer, Shakspeare, Browne (author of "Britannia's Pastorals"), and others, the customs of May-day were not only observed by the vulgar but also by royal and noble personages. The Maypole became very popular, and was raised in every town and village; and Robin Hood, Friar Tuck, Maid Marian, and the Morris-dancers, together with other fantastic masques and revellers, performed their antics round the May-day pole in every town and city. These customs gradually fell into disuse, till the celebration of the day was left entirely to the chimney-sweepers, with their "Jack in the Green," who still go about on May-day in their tawdry finery, merely to beg money from the street spectators. In some country villages, however, a feeble attempt at "going a maying" is made at the present day. The celebration of May-day probably had its origin in the worship of Flora, who was supposed to be the goddess of flowers, and whose rites were solemnized at that season by the ancients. The earliest notice of the celebration of May-day in this country was by the Druids, who used to light large fires on the summits of the hills in honour of the return of spring.—*Ref.* Hone's *Every-Day Book*.

May-fly, *may'-fly* (*Ephemera vulgata*), is the common type of the neuropterous insects of the genus *Ephemera*. It is very plentiful in the early part of summer about the banks of rivulets and stagnant waters. In appearance it is of a somewhat greenish-brown colour, with transparent wings mottled with brown; and there are thin, long, black bristles attached to the extremity of the body. During the day the May-fly is generally observed with its wings closed in a quiescent posture; but in the evening it flutters about over the surface of the water which it affects. (*See* article Ephemera, which enters into the scientific description of this insect.)

Mayor, *may'-or* (Lat. *major*, Fr. *maire*), is the chief magistrate in a borough or corporate town, and in London, York, and Dublin, is styled lord mayor. Their powers and duties depend generally on the provisions of charters, corporate usages, or express enactments in acts of parliament. They are elected annually, and are justices of the peace *pro tempore*.

Mayor of the Palace. (*See* Major Domus.)

Mazurka, or **Mazourke**, *ma-zur'-kă*, a Polish national dance in three-eight time, of a peculiar rhythmic construction, somewhat resembling that of the *polacca*.

Mead, *mead* (Sax *medo*, *medu*), a vinous liquor extracted from honey. It is formed from a solution composed of one part of honey to three of boiling water, flavoured with spices, a portion of ground malt and a piece of toast being added, in order that fermentation may ensue. There is no doubt that mead formed the favourite beverage, for centuries, of the northern people; it is also frequently mentioned in *Ossian*. (*See* Honey.)

Meadow-Saffron. (*See* Colchicum.)

Meadow-sweet. (*See* Spiræa.)

Mean, *meen* (from Lat. *medium*), a term applied in Math. to a quantity which possesses an intermediate value between several others, which are formed according to any assigned law of succession. The *Arithmetical Mean* is the *average* of any series of numbers, and is found by adding the values of the quantities together and dividing by their number. The arithmetical mean a and b, any two quantities, therefore, is $\frac{a+b}{2}$; if $a+b+c = \frac{a+b+c}{3}$, and so on. The *Geometrical Mean* between any two quantities, or the *mean* proportional, is a quantity which forms the middle term of a duplicate ratio, or, in other words, is the continued proportion of those terms; so that the first quantity is to the number sought as the number sought is to the third term. To find the geometrical mean between a and b, any two quantities as before, let x be the required mean,—

$$\therefore a : x = x : b$$

and, consequently, $x = \sqrt{ab}$; therefore the geometrical mean between any two quantities equals the square root of their product. The *Harmonical Mean* is such a number that, the first and third terms being given, the first is to the third as the difference of the first and second is to the difference of the second and third. The harmonical mean, therefore, between a and c may be, say b; and b, or the mean required, $= \frac{2ac}{a+c}$.

Measles, *meaz'-lz* (Lat. *Rubeola*), is a contagious fever of an inflammatory type, attended with a characteristic eruption, and all the symptoms of a violent cold; watery discharge from the eyes and nose, dry cough, hoarseness, &c. It commences with the ordinary symptoms of fever,—chilliness, loss of appetite, lassitude, and almost invariably attended with inflammation of the mucous membrane lining the air-passages. The eruption commonly appears on the fourth day; at first about the head and neck, then the trunk and arms, and finally reaching the lower extremities. It takes two or three days to complete its course, and when it reaches the feet and legs, it has usually begun to disappear from the face. At the end of six or seven days from their first appearance, the papules have again disappeared. The eruption consists of little papules somewhat resembling flea-bites of a dark-red colour. When the eruption is fully out, the cough, at first dry and troublesome, generally becomes softer and less frequent. All ages are liable to attack, though infants at the breast are not so liable as those somewhat older. It is not commonly a dangerous disease, though sometimes it has proved exceedingly fatal. Where danger occurs, it is from inflammation of the air-passages, when the disease may become complicated with croup; or in subjects predisposed to consumption,

the seeds of that disease may be developed. In general, a simple diet and the maintenance of an equable temperature is almost all that is required, with, perhaps, the exhibition of a mild diaphoretic or expectorant. Sometimes the application of a mustard cataplasm to the chest is of advantage.

Measure, *mezh'-er* (Fr. *mesure*), that division of the time by which the air and motion of music are regulated. Although some affirm it to be of modern invention, there is no doubt that the ancients not only practised the division of time, but formed it upon very severe rules, founded upon principles unknown to the modern musicians.

Measures. (*See* Weights and Measures, and Metric System.)

Mechanical Drawing.—In this article we purpose explaining, by the help of appropriate diagrams, the easiest methods of delineating various portions of machinery. To avoid repetition, the pupil is requested to observe that, in all the lessons, the centre-lines drawn on the various diagrams must be drawn on the paper on the board, it being understood that where a copy is presented him in this book, or elsewhere, without centre-lines being given on it, that these should be adopted and drawn in faint lines, so that data may be obtained from which to take measurements. By dint of practice the facility for copying without these will be attained, or, at least, they will be sparingly required. As the pupil proceeds, he will the more readily decide as to the quickest method of finding datum-points from which to take measurements. Fig. 1 represents a "bolt," *c b*, with the solid head *e' d*, and movable "nut" *g' g*. This is used for strongly fastening various portions of machinery together. For examples of the method of using this, see the work on *Mechanics and Mechanism* by Mr. S. Burn. To draw the figure now given:—Suppose the copy to be without the centre-line; bisect *e' e'* in the point *a*, draw *a b'*. On the paper on the drawing-board draw two lines, *e' e'*, *a b'*, at right angles to each other; with *a e'* from the copy measure from the point of intersection of the above lines on the board *a* to *e' e'*; from *a* measure to *b*, from *b* with distance *a e'* measure to *d d*, join *d e'*, *d e'*.

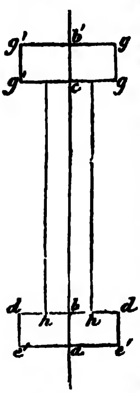


Fig. 1.

From *a* measure to *c* and *b'*, from these points with *a e'* measure to *g' g*, *g' g*; join *g' g'*, *g g*. From *b* measure to *h h*; parallel to *a b'* from *h h*, draw lines meeting *g' g*. Fig. 2. Bisect the line *b' b'* of the copy in the point

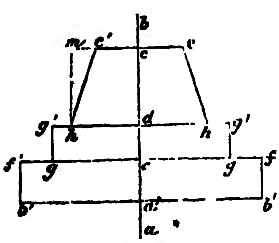


Fig. 2.

a', and draw *a' b*. On the paper on the board draw two lines corresponding to these, intersecting at the point *a'*. From *a'* measure to *b'*, *b'*, from *a'* measure to *c*; with *a' b'* from this point measure to *f f*; draw a line parallel to *b' b'* through *c*; join *f b'*, *f b'*. From *a* or *c* measure to *d*, and through this draw a line parallel to *b' b'*. From *c* measure to *g*, *g*; join *g' g'* by perpendicular lines to *g g* on the line *f f*. From *a'* mea-

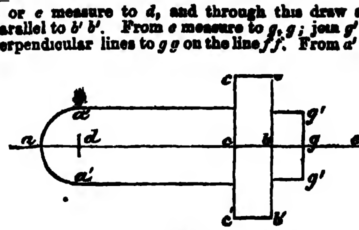


Fig. 3.

sure to *e*; draw a line through this parallel to *a b'*; from *e* measure to *e'*, *e*; from *d* measure to *h*, *h* on the line *g' g'*; join *h e'*, *h e'*. Where we use the terms "measure from"—as measure from *a'* to *b*—we mean, in all instances, that the measurement *a' b* is to be taken from the copy and transferred to the paper on the

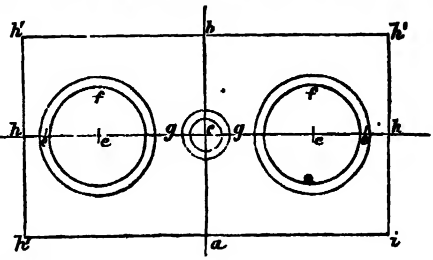
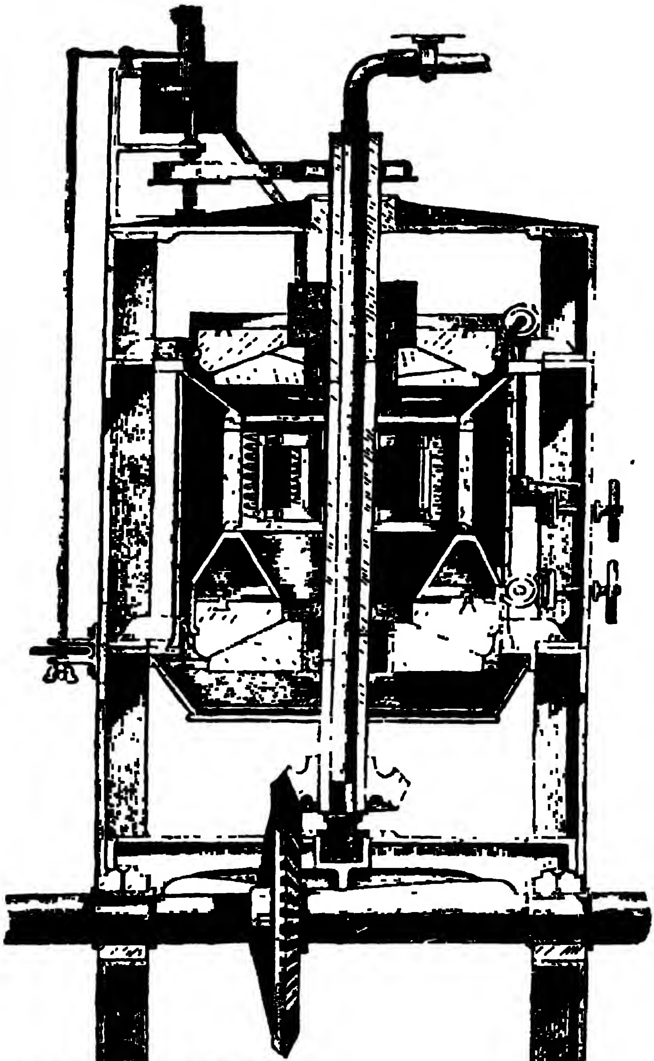


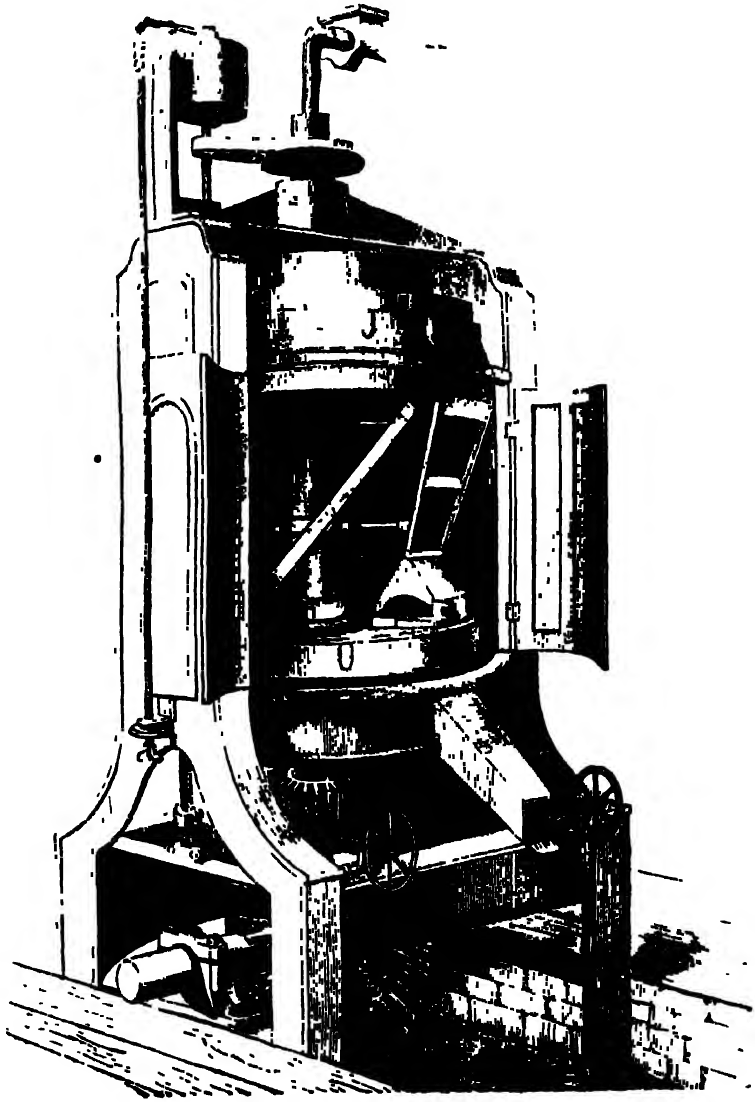
Fig. 4.

board, from the point thereon corresponding to the point *a'* in the copy. Again, when we say "measure from *a'* to *b'*," we wish the pupil to take the measurement *a' b'* from the copy, transferring it to the line on the paper corresponding to the line *b' a' b'* in the copy, from the point on the paper corresponding to the point *a'* in the copy. Hence the pupil will observe the use of datum-lines—as *a' b*, *b' a' b'*—from which to take the measurements from the copy; these to be transferred to the paper on the board on which the fac-simile is to be constructed. As a means of enabling the pupil readily to decide on datum-points from which to take measurements, we explain another method of copying the last figure. Draw any line

can be quickest put in by using one; however, it may be done as follows:—Measure from *d* to *h*; from *h* draw a line to *m*, at right angles to *g' d' g'* with *d e* or *a e'* measure to *e*, and draw through this a line *e' e* parallel to *a' b'*. From *m* measure to *e'*, and from *e'* to *e*; join *h e'*, *h e*. In the following diagram the use of the circle is shown. Fig. 3. Draw any two lines on the board corresponding to *a e g' g g'* in the copy. From *g* measure to *b*, *c*, and *d*; from *g* measure to *g g'*, and from *b* to *b' b'*; join *g' g'* to *b' b'* by lines at right angles to *g' g'*. From *c* measure to *c' c'*; join *b' c'*, *b' c'*. From *d*, with *d a'* as radius, describe a semicircle *d a' a'*; by lines parallel to *c b* join *a' a'* with the line *c' c'*. Fig. 4. Draw on the board two lines corresponding to *a b*, *h h* in the copy. From the point of intersection *c* measure to *a b*, and *h h*; through *a b* parallel to *h h* draw lines *h' h'*, *h' i*; through *h h* parallel to *a b* draw lines meeting those in the points *h' h'*, *h' i*. From *c* with *c g* put in the circle; from *c* measure to *e*, *e*. From these points, with *e' e'*

PLATE LXXXVII.—MECHANICAL DRAWING.





Mechanical Drawing

as radius describe the circles, and also the interior ones, as *e f*. Fig. 5. Draw on the board, lines *a b*, *c c*, at right angles intersecting at *e*, corresponding to those in the copy. From *e* measure to *a* and *b*; from

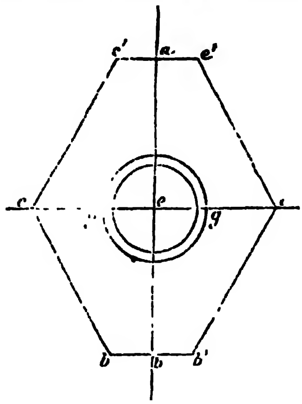


Fig. 5.

these points draw lines parallel to *c c*, from *a b* measure to *b b'*, *e' e'*. From *e* measure to *c c*, join *c c'*, *c b'* and *c e'*, *c b'*. The radius of the circle in the centre is *e g*. Fig. 6. Draw lines corresponding to *b d c*, *h h*,

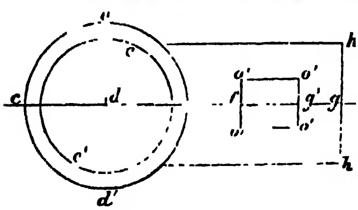


Fig. 6.

in the copy. From *g* measure to *d*, put in from *d*, as a centre, the circles *d' d'* and *e' e'*. From *g* measure to *h*, *h* and parallel to *h* [illegible] from these draw lines [illegible] the circle [illegible] measure to [illegible], and *f*, [illegible] draw lines parallel to *h h* and [illegible]. Fig. 7 [illegible] what

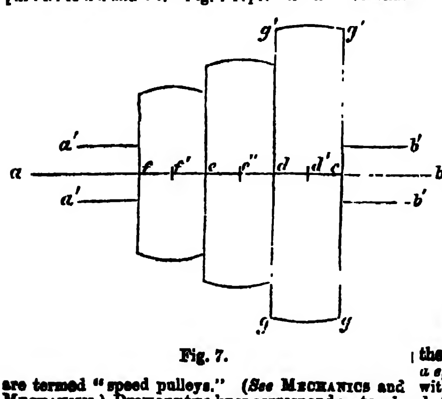


Fig. 7.

are termed "speed pulleys." (*See* MECHANICS and MECHANISM.) Draw any two lines corresponding to *a b*, *g g*. From *e* measure to *d*, through this draw a line parallel to *g g'*; measure from *e* and *d* to *g'*, *g*. Bisect the distance *d e* in *d'*; from *d'* as a centre, with *d' g'* as radius, describe the arcs joining the line through *g' g*. In like manner, measure from *b* to *c* and *f'*, *c'* will be the centre of the arcs joining the lines drawn through *e* and *f*. Fig. 8 represents a projecting "snug"

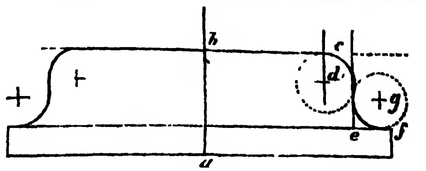


Fig. 8.

by which two parts may be joined by means of a bolt secured by a nut, passed through holes bored in each. Draw the line *a b*, and another at right angles to it. From *a* measure to *b*, and put in the various horizontal lines and the base; from *b* measure to *c*, and parallel to *a b* draw a line from this point. From *c* measure to *d* from *d* as centre with radius *d c* describe the curve. From *f* measure to *e*, a line drawn from this, parallel to *a b*, gives the end-line. The centre *g* (as also *d*) is found by trial on the copy, and the points transferred to corresponding parts on the board. The line *d e* represents one method of transferring them. Fig. 9 represents a side view of a

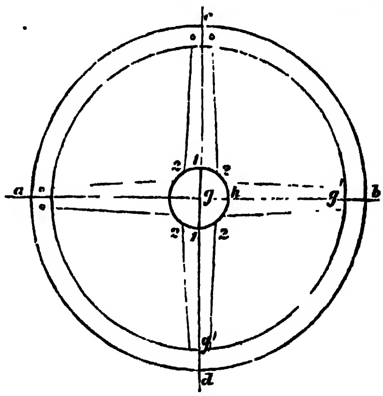


Fig. 9.

"pulley," or "drum," showing the arms and centre. Draw any two lines corresponding to *a b*, *c d*. From *g* as centre, with *g b* as radius, describe the circle, and also the interior circle *g' g'*, from *g* with *g h* put in the small circle representing the diameter of the centre or eye of the wheel. From the lines 1, 1 with distance 1, 2 lay off on either side of all the centre-lines of the arms; next, from the points where the interior circle cuts these lines at the points *g' g'*, lay off on each side equal to half the thickness of the end of the arm as it joins the inside of wheel. Join the points thus obtained with those previously obtained on the centre of the wheel, as 2, 2. Fig. 10 represents the plan of a circular cylinder or receptacle, the small circles showing the position of the circular heads of the bolts used for attaching the cover to the main body of the receptacle. The method of finding the centres of the small circles is as follows: Draw any two lines *a e*, *b d*; from the point of intersection as centre, with radius *a b*, *a c*, describe circles; bisect the distance between these, as *b c*, in the point *f*. From *a* as centre, with *a f* as radius, describe a circle

f e d: the centres of the small circles will be found on this line. Find the position of any two of the circles, as *f e* or *e d*; transfer these points to the board. I

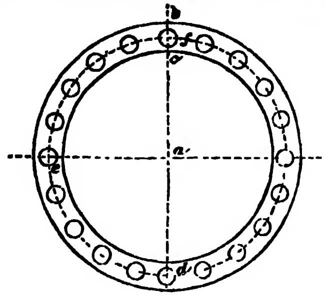


Fig 10.

the copy, the centres of four of the circles will be found where the diameters *e a*, *b d* cut the circle drawn through *f d*. Count the number of circles between *f* and *e*, or *e* and *d*, divide the circular line passing through *f*, and between *e* and *f* or *e* and *d*, into as many equal parts as will give as many centres as there are circles in the copy: these points will be the centres of the circles. Fig. 11 represents the plan

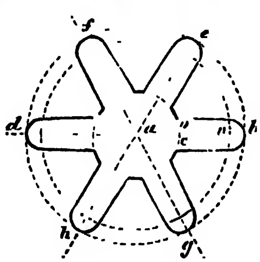


Fig 11.

of a small thumb-wheel attached to the head of a screw-bolt, by which it may be easily moved by means of the finger and thumb. From *a* with *a b* describe a circle, draw the diameter *d b*, divide the semicircle *d b* into four equal parts in the points *e f*, from *a* draw lines through *e f*; and continue these to cut the other semicircle. From *a* measure to *n*, the centre of the circles forming the ends. With *a n* describe a circle: the points on the radial lines, as *n*, where this intersects them, are the centres of the circles which terminate each radial arm. From *a* describe the small circle *a c*, from the points where this intersects the radial lines, as *c*, lay off on each side of these the distance *c o*, join the points thus obtained on the circle *a c o* with the extremities of the circular ends. Another way of joining the radial arms to the centre or eye may be understood by inspection of the diagram in fig. 12, where *a b* are the centres of the circles, part of which joins the arm with the centre. Fig. 13. Draw any two lines corresponding to *a b*, *d d* in the copy; from the point of intersection *c* measure to the points *h*, *g*; through these draw lines parallel to *d d*. From *h*, *g* measure to *m m*, *h h*; join *m h*; put

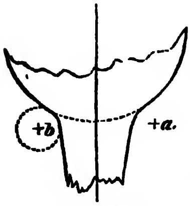


Fig. 12.

in, in like manner, the internal parallelogram *l i*, *l i*. From the point *c*, with radius *c e'*, *c a'*, and *c a*, describe

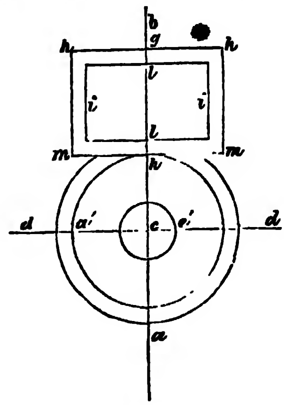


Fig. 13.

the circles as in the copy, meeting the line *m m*. Fig. 14 represents plan of part of a "valve-plate." From any centre *a* describe a circle *a b*, and one within this, as *a c*; continue this last all round, the part from *m*

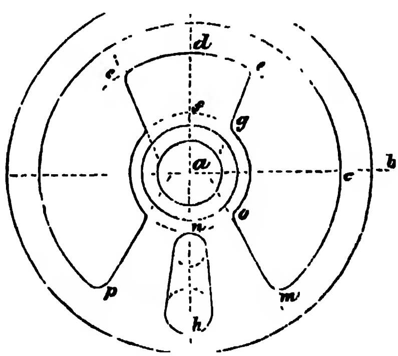


Fig. 14.

to *p* being afterwards rubbed out when the drawing is finished and inked in. From *a* with *a d* put in part of a circle *e d e*. From *d* measure to *e*, *e*, and through these draw lines to the points, as *g*, on each side of the line *f*. On each side of the line *a h* measure to *p* and *m*, also from *n* to *o*; join *m o*. Put in the circles at *n* and *h*; join them as in the drawing. Fig. 15 represents the plan of a "lever." Describe the circle *a h*, draw through *a* the diameter *b a d*; from *a* measure to *e*; put in the circle *c d*. Bisect *a c* in *e*, and through this draw a line at right angles to *a d*, as *f f*. In the copy take the points *f* (where *e f* intersects the curve), *h*, and *g* (where the curve *h g* touches or joins to the circles described from *c* and *d*). By means of these points, to find the centre of a curve, three points in that curve being given, the centre *m* will be found. Fig. 16 represents the method generally employed of constructing the central part of a "spur-wheel." The circles *e*, *f*, and *m* are described from the centre *d*, the circle *m* is divided into as many equal parts as there are arms in the wheel, any central point of these,

Mechanical Drawing

as *m*, being adopted as the datum-point from which to take the measurements. The space between any two of these arms, as *a b*, is bisected, and a line, as *d f*, drawn. By measuring from *f* to *e*, *g*, the centres of the curves at *e* and *g* will be obtained, the centre of

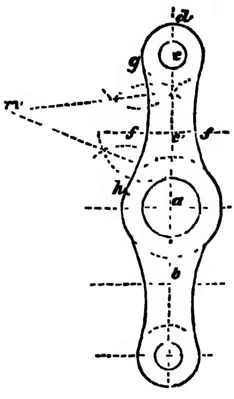


Fig. 15.

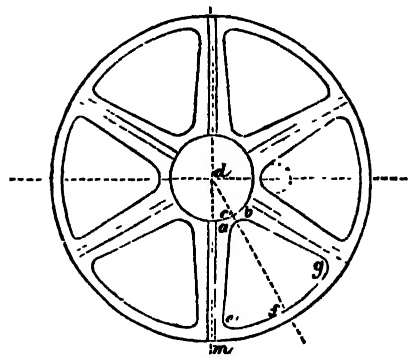


Fig. 16.

the curve *a b* is also on the line *d f*. Fig. 17 represents the plan of the pulley with curved arms. The method of describing these is explained in fig 18. The first operation necessary to be done is to find in the copy, fig. 17, the centres of the circles forming the curves. these must be found by trial. Next draw two lines at right angles, as in fig 18, intersecting in the point *a* corresponding with the centre *c*, fig. 17. From *a* describe circles representing the rim and the eye of the wheel in last figure. From *c*, in fig. 17, measure

Mechanical Drawing

will be found. Put in the circle representing the eye of the pulley, and draw a diameter *a b*; draw a line in the copy corresponding to this, and measure from *b* to the point representing the centre of the circle from which the curve *e c* is drawn, as *d*; transfer this to the copy, and from *d* with *d e* draw the curve *e c*; from *c* measure to *f*, thus giving the breadth of arm at eye; from *f*, with the radius of the curve *f* taken from the copy, cut the circle *o* in *o*, from this point with same radius describe the curve *f g*. The various points denoting the centres of the curves are given in the circles, the points *e*, *e* being those where the curves join the central circle or eye of the pulley. Fig 20 represents the bottom part of foot of a cast-iron framing. Draw a line, *c d*; from *c* measure to *a* and

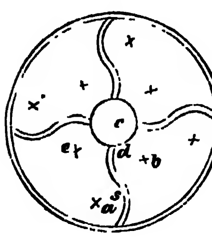


Fig. 17.

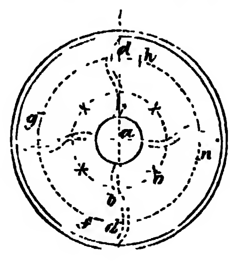


Fig. 18.

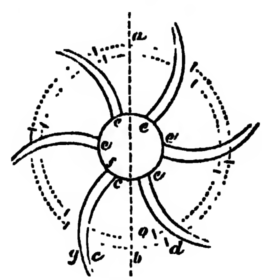


Fig. 19.

to the centre *b*, from which the curve *d* is described, and from *a*, fig. 18, a circle *a o* on this line the other centres, as *e*, fig. 17, will be found. In like manner, from the centre *c*, fig. 17, measure to *a*, from which the curve *a s* is described, and from *a*, fig 18, describe the circle *g h*. On this will be found the second set of centres. From *d* measure to *h*, from *h* to *n*, from *n* to *f*, and from *f* to *q*. these are the various centres. Or the curves next the eye may be drawn in first, and the curves with radius *a s* be described, to meet these from the circle *g h*. In this example the arms are of uniform breadth; where they get gradually less from the centre or eye of the pulley outwards, the method of describing them may be learned from fig. 19. The points from which the curves are drawn must be found, and corresponding points transferred to the paper, as in last example. Two circles, as *d*, *o*, will thus be obtained, in which the centres of the various curves

b; through these draw lines perpendicular to *c d*; with *a c* from *a* describe the curve *c o*. From *b* measure to *e*. Find the centre of the curve joining *o e*, at *f*. Find by any of the methods already described the point *m*; join *m d* by the curve. Fig. 21 represents part of the framework forming the support for the bearings *e* in which vertical spindles revolve. Draw *a b*, *a d*; measure from *a* to *d* and *c*; draw *c e* at right angles to *a d*. From *e* measure to *f*, and from *f* draw to *g* parallel to *a b*; from *a* measure to *h* and *m*. The centre of the curve joining *f m* will be found at *g* on the line *f g*. The method of filling in the drawing is shown by the other half. Fig. 22 represents the outline of side elevation of framing. Draw the line *a b*, and at right angles to it 2′ *d*; measure from 2′ to *a′ a′*, and to 3′. Through these points draw lines *d d*, *a′ e′*, *a′ c′*; join the points *c′*, *d* by the part of the circle, as in the diagram. From 2′ measure to *f*, and draw the line *t f t*;

Mechanical Drawing

from *f* measure to *t t*; from these points draw lines parallel to *2′d*. From *t* measure to *n*; draw *n n′*, and from *n*, *n′*, with radius *n n′*, describe curves meeting, as in the drawing. From *f* measure to *f*, and draw

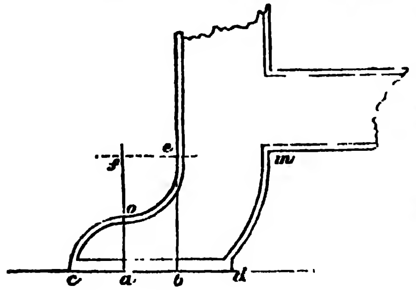


Fig. 20

h f h; from *h*, *h*, with radius *h h*, describe curves meeting in *g* on the line *v r*. The curves 5, 6, and 3 are described from the centres *n′*, *n*, and 4, 6 from centre *h* on the left-hand side of *f f*. The lines *m m*, *o o* are

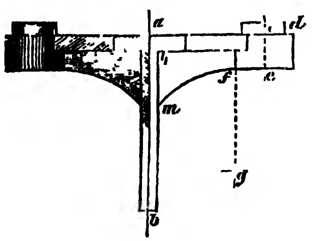


Fig. 21.

joined by curves described from the centre 3, which centre is found by describing arcs from the points *m o*, with any radius greater than half *m o*, and joining the intersection of these arcs by a line as in the copy. Fig. 23 is another outline representing the side elevation of framing. The curve *h* is described from the centre *f* on the centre-line *b f*; the centre-lines of the other parts are at *m*, *e*, *d*, and *c*. Fig. 24 is another form of framing. The centre of the curve *n*, joining the lines from *m*, *m*, is at *h*, on the centre-line *o h*; the centres *d*, *d* are on the line drawn through *c* to *h b*, parallel to *m m*; the centre of the circle *e* is at *g*. Fig. 25 represents the front elevation of a "cross head" and "side levers." The centre-lines are *a d*, *e h*, *v r*. The plan is shown below, the lines of which are obtained by continuing those of the upper figure, as in the drawing. Fig. 26 represents the front elevation of the cover for a gas retort. The centre of the parts *b*, *c*, and *d* is at *a* on the line *d e*; the centre of the curve joining *o p* at *m*, on the line *n m*. Fig. 27 represents the "transverse vertical section" of a boiler *a b*, and its brick "setting." From *a* with *a b* describe the circle *a b*; from *a* measure to *c*; draw *c d*, and from *d*, *d e*. From *d* measure to *g*, from which point a line drawn parallel to *c d* marks the point *f*, where the curve *f o* terminates at the boiler. The point *n′* is the centre of the curve *f o′*, transfer this part from *f* to *n′*, and describe *o′ f*. From *a* measure to the lines *o s*, *n m*, and draw lines through these parallel to *c d*; measure from *d* to *s* and *q*. The centre of the curve *o′ h* is at *s*, and that of the curve *h r* at *m*. Fig. 28 represents an "angular-threaded screw." To copy it, proceed as follows: Measure from *a* to *d*, and from *d* to *e*, 1, 2, 3, &c. These are the points through which the centre-lines of each thread are drawn. From *a* measure to *f*, and draw *f q*, and from *a* to *b* and *c*, and draw *b n*. From *f* on the line *b f* measure to *g*, and from *b* to *n*; through *d* draw *n d g*, and parallel to this, through *e*, 1, 2, 3, &c., draw lines. Next, from *d* measure on each side of *d g*, equal to half the breadth of each thread, to *n′*. These lines terminate at the perpendicular *b n*; join the angles as in the drawing. Fig. 29 represents a "square-threaded screw." From *e* measure to *a*; *a b*, *b c*, *c d* represent the thickness of each thread and the distance between them; the line from *g* is the line of the inside of the screw, the line *f* the outside line of the threads. The last example shows the method of copying this.

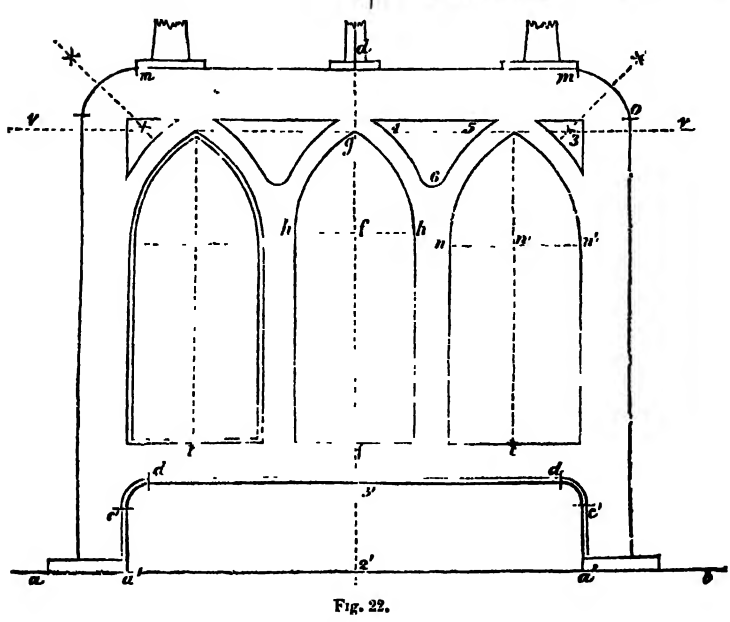


Fig. 22.

Mechanical Drawing

Fig. 30 represents a "helix" of wire, *a* being the centre-line, *d e* being half the thickness of the coil, the lines from *c*, *b* intersecting those drawn parallel to *d*, giving the centre of the circles forming the termination of coils.

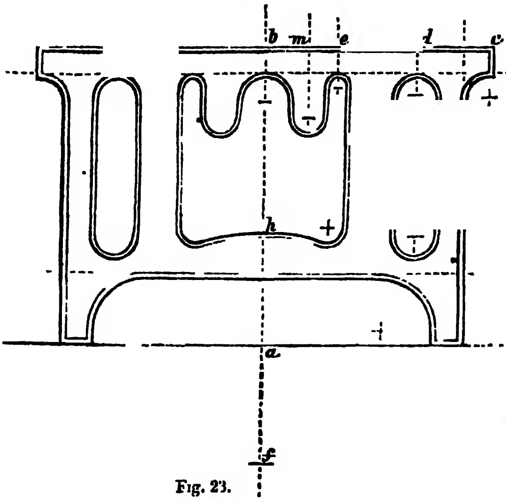


Fig. 23.

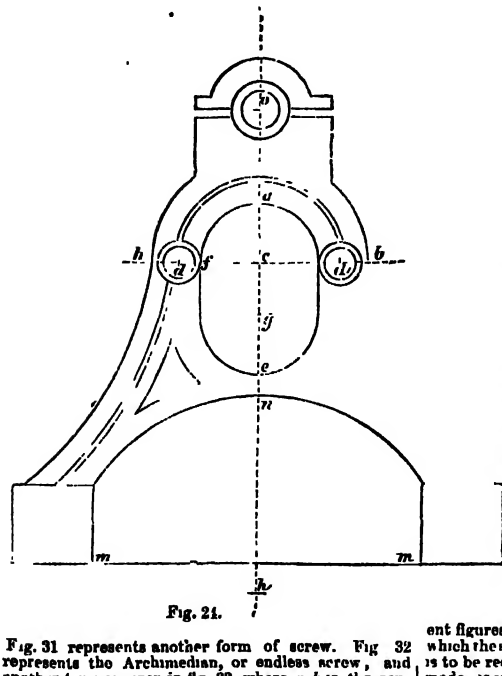


Fig. 24.

Fig. 31 represents another form of screw. Fig 32 represents the Archimedian, or endless screw, and another form is given in fig. 33, where *a b* is the central shaft round which the helix or thread *e e* is coiled, according to a determined pitch. Fig. 34 shows the method of drawing in the teeth of wheels. Let *c x* be the diameter of wheel from centre to outside of teeth. The circle, of which part is shown, and of which *c b* is the radius, is termed the "pitch-circle or line." It is on this line that the number of teeth are marked off Having ascertained the diameter of pitch-line, the depth of teeth, and the number of them, divide the pitch-circle into as many equal parts as there are to be teeth in the wheel, and proceed as follows: Let *a*, *b*, 4, 5, &c, be the divisions on the pitch-circle representing the centres of teeth, divide the distances between them into two equal parts, as at *d*. From *d* as a centre, with *d b* on both sides of the point *d*, describe arcs of circles as *f b*, joining the pitch-circle and the outer circle, giving the termination of the teeth as the circle *x* 1. Proceed in this way till all the arcs are made to join the circle *x* 1, 2 *d*. The bottom of the teeth are formed by radial lines drawn as from *e e* to the centre *c*, as in the diagram. The method of drawing the side elevations of toothed wheels may be seen in fig 35. The small dotted circles show another method of describing the form of teeth. The manner of delineating bevil-wheels may be gathered from the two following figures Fig. 36. Let *a b* represent the centre-line of the wheel, *c d* the line of its greater diameter or "pitch-line," *f* the line giving termination of teeth, *d m* being the breadth of the teeth: The teeth on the part between *c v*, *d m* converge to the point *b*, those between *k d*, *c n* to the point *a*, on the line *a h g*, *e f b*. It is foreign to the purpose of this work to go into the subject of the teeth of wheels, belonging, as it does, to a strictly technical department; we cordially recommend, however, to the pupil anxious to study this interesting and important department, Buchanan's work on "Mills and Mill Gearing," edited by Sir John Rennie, and the "Engineers' and Machinists' Assistant," by Blackie of London and Glasgow. Both of these works, although somewhat high-priced, abound in valuable information. To proceed with our explanation. The method of copying the teeth of bevil-wheels may be seen in fig 37, where *a b* is the centre-line of wheel, *e g* the pitch-line, *e h* the line terminating the teeth on the back part of the wheel *e g* The line *x x* gives the termination of the inside of the teeth, *d f* that of the outside; the lines *g o*, *g f* are projected towards points on the line *a b*, corresponding to *a b* in fig. 36. The distances between the teeth are set off on the line *e h* to *m*, *h*, *p*, *s*, *t*, &c.; lines are drawn from these to the point on the line *a b*, to which *o g* converges; these lines are produced to meet the line *e g* in the points 1, 2, 3, 4, 5, &c. From these points, lines, as 1, 6. 3, 7, 5, 9, are drawn to the point on the line *a b*, to which *g f* converges; these lines are terminated by the line *d f* From the points *h*, *s*, *v*, &c., lines are drawn to the same point on *a b*, as 5, 9, &c, these being terminated by the line *x x*; the points 6, 7, 9, &c., are then joined to these, as 6 *z*, 2 *t*, &c The pupil should put in the whole of the wheel, of which only half is here given. Mechanical drawings are reduced or enlarged quickest by means of what are termed "proportional compasses." If these are not available, "scales" should be drawn from the different figures. Thus, to reduce the drawing in fig. 38, of which the scale is given in fig. 39. Suppose the drawing is to be reduced one-half, a scale half fig. 39 is to be made, as in fig 40; and as each measurement is taken in the compasses from fig. 38, it must be applied to the scale in fig. 39. Suppose this distance is found to be

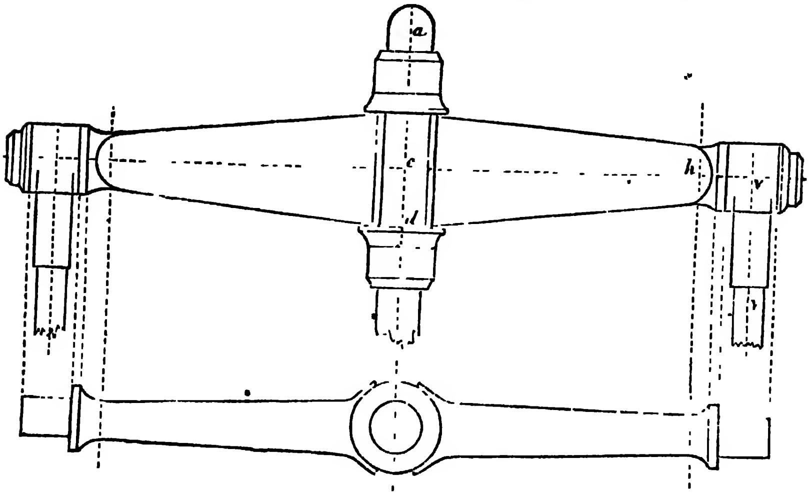


Fig. 25.

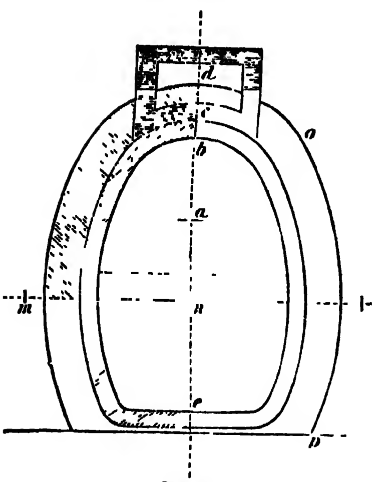


Fig. 26.

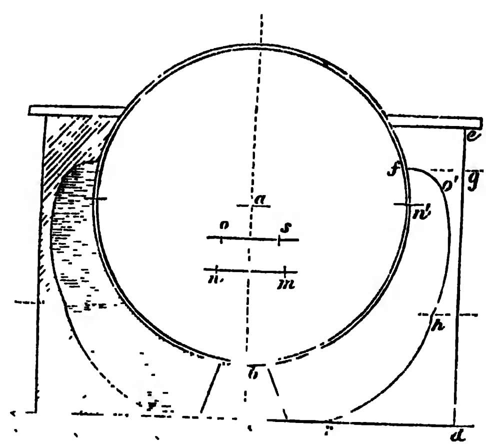


Fig. 27.

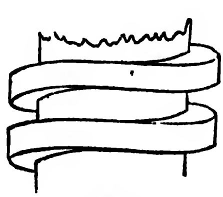


Fig. 31.

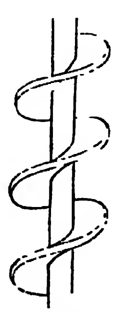


Fig. 32.

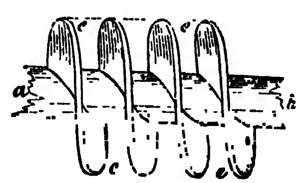


Fig. 33.

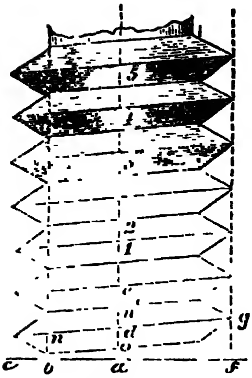


Fig 28.

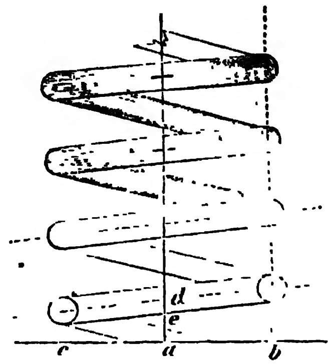


Fig. 30

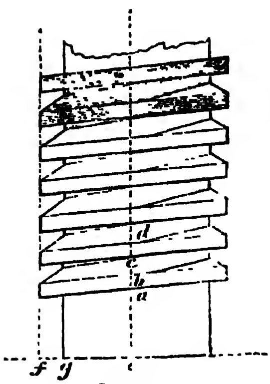


Fig. 29.

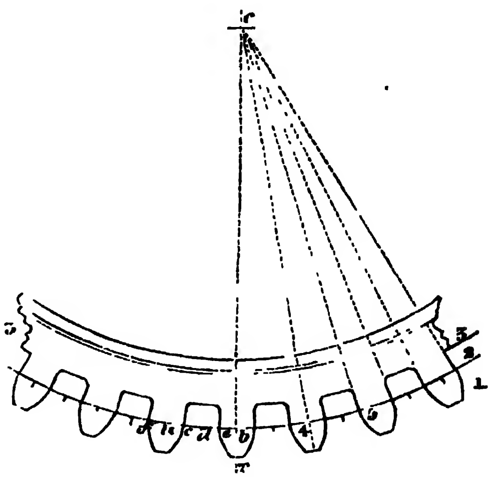


Fig 34

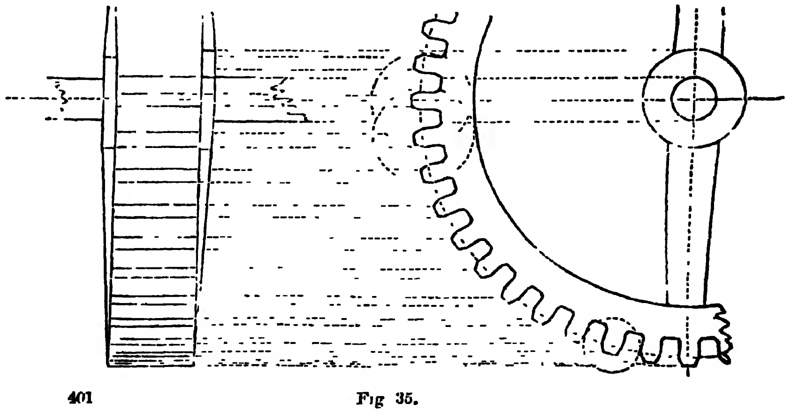


Fig 35.

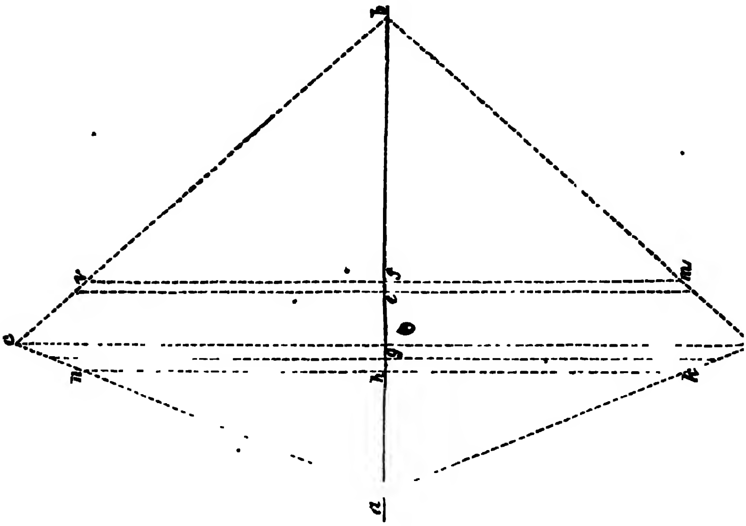


Fig. 36.

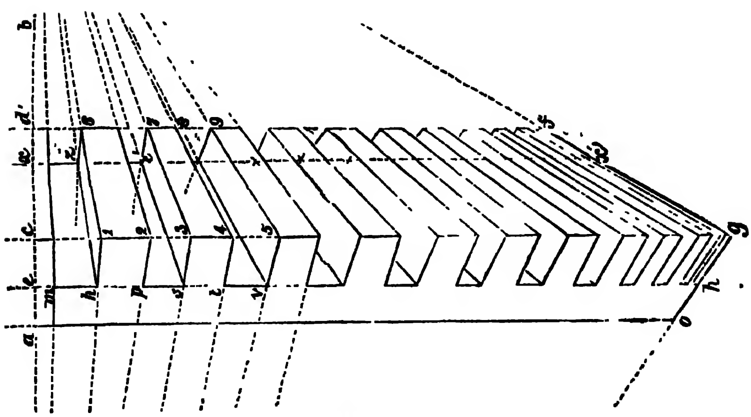


Fig. 37.

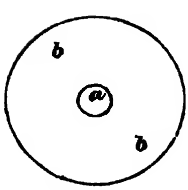


Fig. 44.

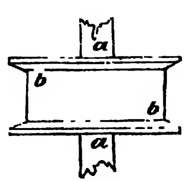


Fig. 45.

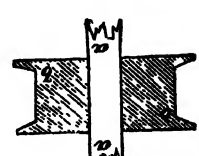


Fig. 46.

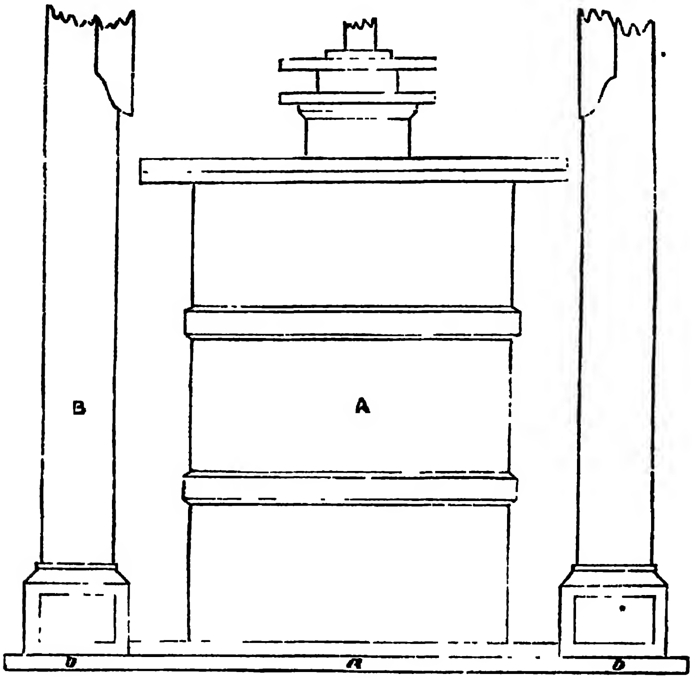


Fig.

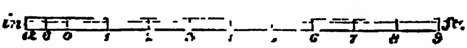


Fig. 39.

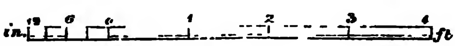


Fig. 40.

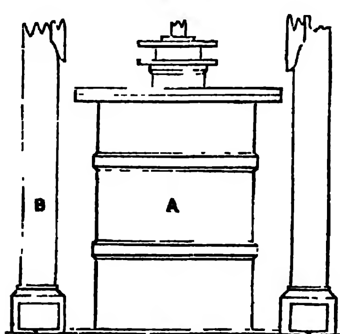


Fig. 41.

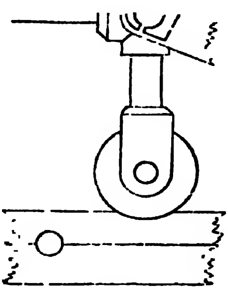


Fig. 42.

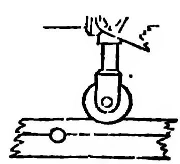


Fig. 43.

6 feet, then the distance of 6 feet must be taken from the scale of fig. 40; and the line thus obtained must be drawn in a situation corresponding to that in fig. 38. The result will be a reduced copy, one-half of the size, as shown in fig. 41. To reduce by means of the proportional compasses: Having previously set them at the desired mark on the scale attached to each instrument, according to any proportion as desired, all that is necessary to be done is to take any measurement with one end; the distance corresponding to this, reduced or enlarged, is given in the other ends. This being transferred to paper, the desired distance is obtained at

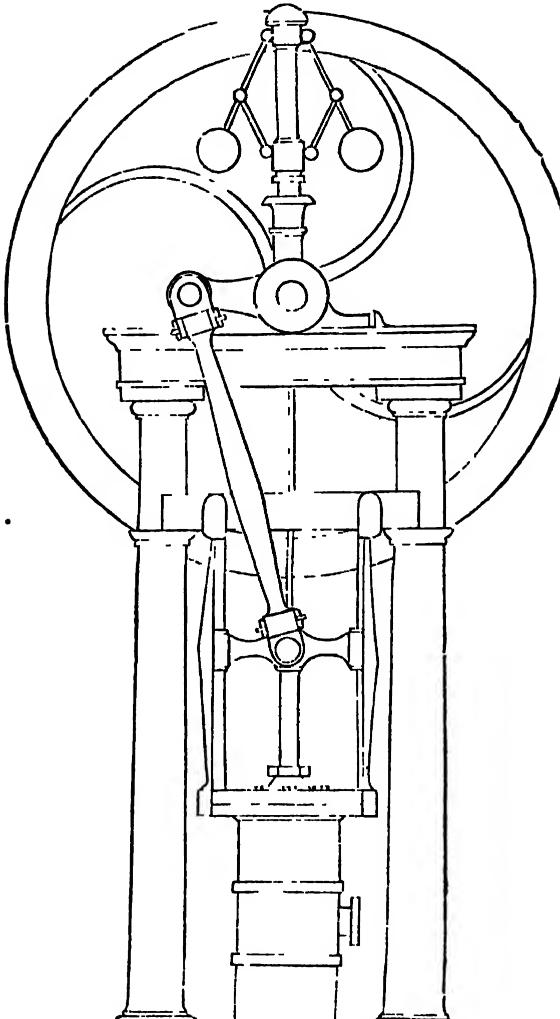


Fig 47

once. To reduce by means of the ordinary compasses, without the use of a scale as just described in figs. 38-41, is a matter requiring greater time, and accuracy of adjustment of the compasses is indispensable. Suppose a b, fig. 41, to be the points representing the intersection of the centre-line of the parts A, B with the base-line a b, and that a line corresponding to the centre-line from a was drawn on paper, and that half the distance a b in the copy was to be transferred to the paper, half of a b would have to be found in the first place on the copy and transferred. By proceeding thus, a copy of fig. 41, but only half its size, would be obtained. The enlargement of figures is exactly the *converse* of what we have described in figs. 38-41.

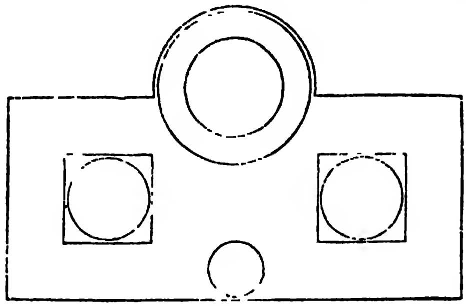


Fig 48

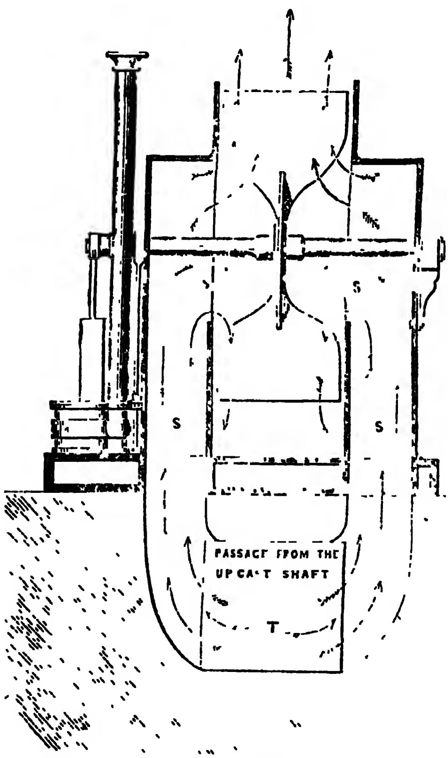


Fig 49.

Fig 42 is a drawing which is reduced half in fig. 43. Mechanical drawings are delineated in three ways: as "plan," shown in fig 44, which represents the "plan" of a pulley or solid drum, in "elevation," as in fig. 45

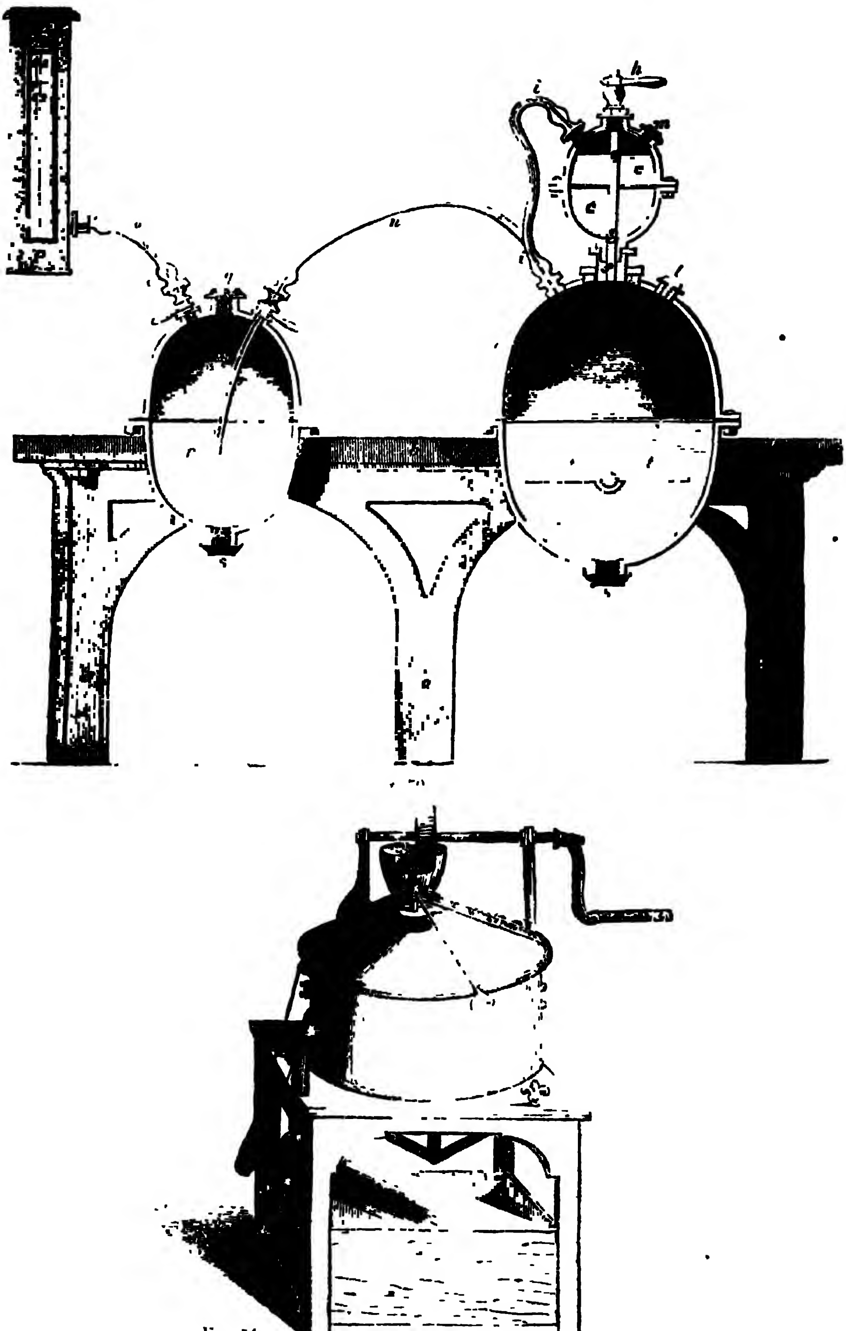


Fig. 51.

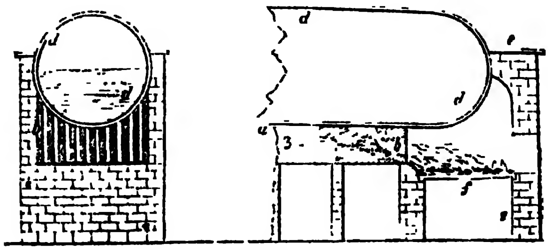


Fig. 51

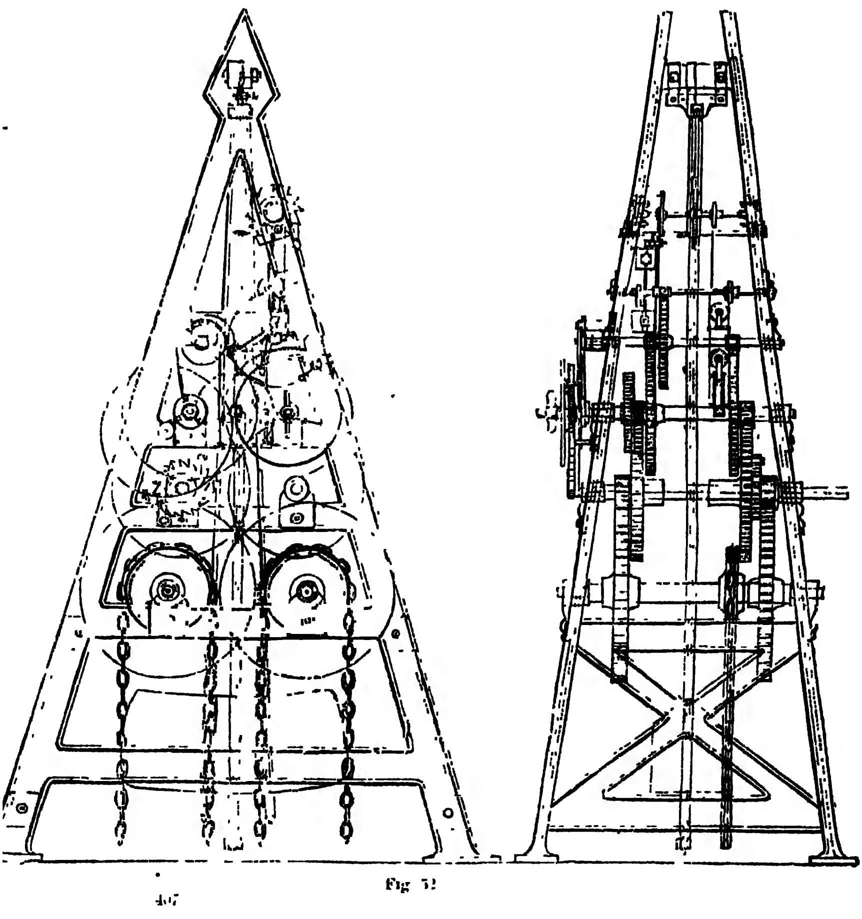


Fig. 52

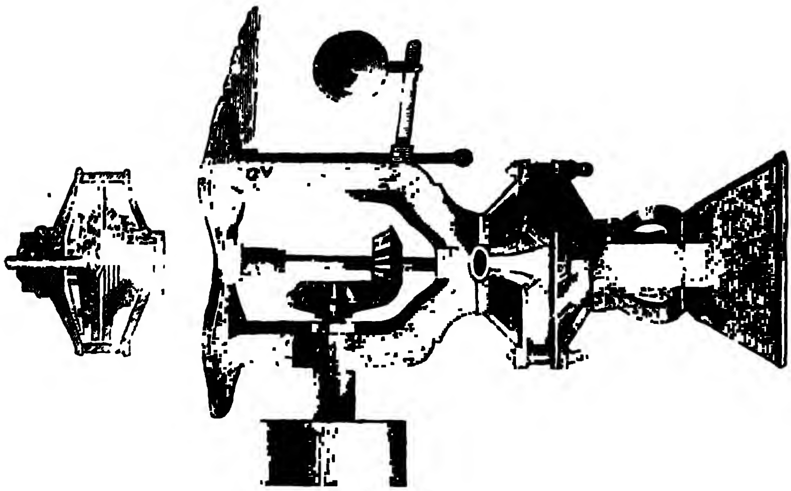


Fig. 53.

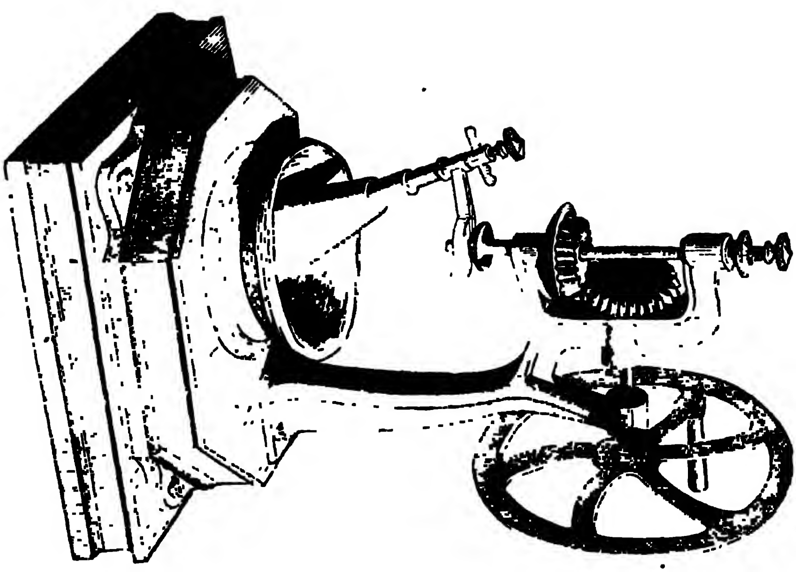
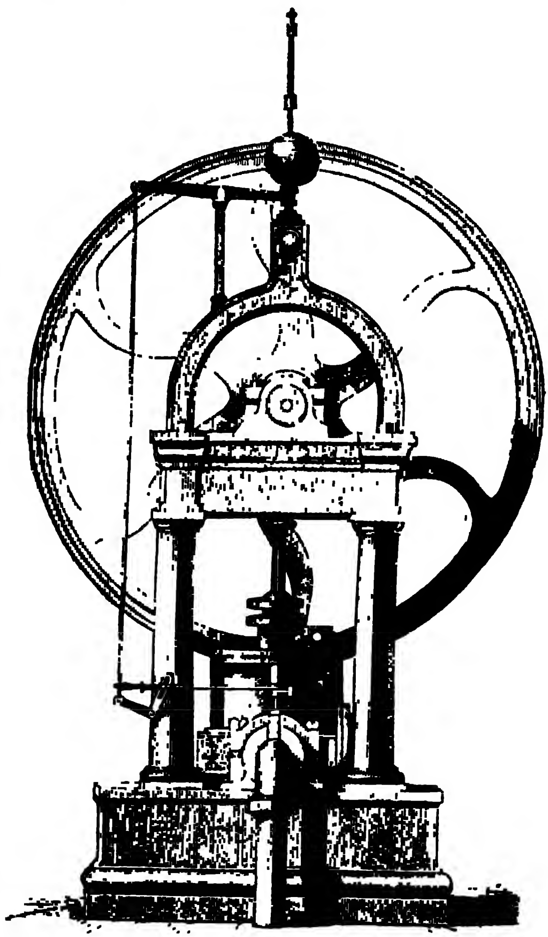


Fig. 58.

Mechanical Drawing

which is the elevation of fig. 44. Elevations may be "front," "back," "end," or "side." In "section," as in fig. 46, which is a transverse vertical section of figs. 44 and 45. The same letters of reference denote the same parts in these three sketches Sections may be divided into "transverse" and "longitudinal," these being either vertical or horizontal. In finished outline-drawings, shadow-lines are made use of. The light, in the generality of examples, is supposed to come from the top and left-hand side of the drawing, thus throwing the right hand and under lines in shadow. These are therefore made darker in inking-article on "Perspective," to which we refer the reader. Fig. 49 is a transverse vertical section of Nasmyth's steam ventilating-fan. Fig. 50 is a longitudinal vertical section of an aerated water-machine. Fig. 51 is a longitudinal and transverse vertical section of a smoke-burning furnace. Fig. 52 is "side elevation" and "end elevation" of Roberts's Alpha clock. Fig. 53 represents a side-elevation of a corn-mill, with section (vertical) through the grinding-plates. Fig. 54 is a perspective view of another form of portable corn-mill. Plate LXXXVII is a transverse vertical section of the "patent conical flour-mill," of which the



Fig

in the drawing, as exemplified in fig. 47, which is the outline drawing of "front elevation of high-pressure steam-engine," the plan of sole-plate of which is given in fig. 48 We now proceed, as a conclusion to this article, to give a few examples to serve as copies to the student, in copying which he will find his operations much facilitated if he has paid full attention to the preliminary lessons. The copies given in perspective are set out by the rule given in the perspective view is given in Plate LXXXVIII. Fig. 55 is front elevation of a fixed high-pressure steam-engine. Fig. 56 is a perspective sketch of a fire-engine of the old "manual" description. Fig. 57 is a side elevation of a "disc-pump." Fig. 58 is a perspective sketch of a "drug-grinding-machine" In the various examples we have given, the pupil will perceive the method in which the various parts are shaded in order to represent round parts, flat, and so on. Mechanical outline-

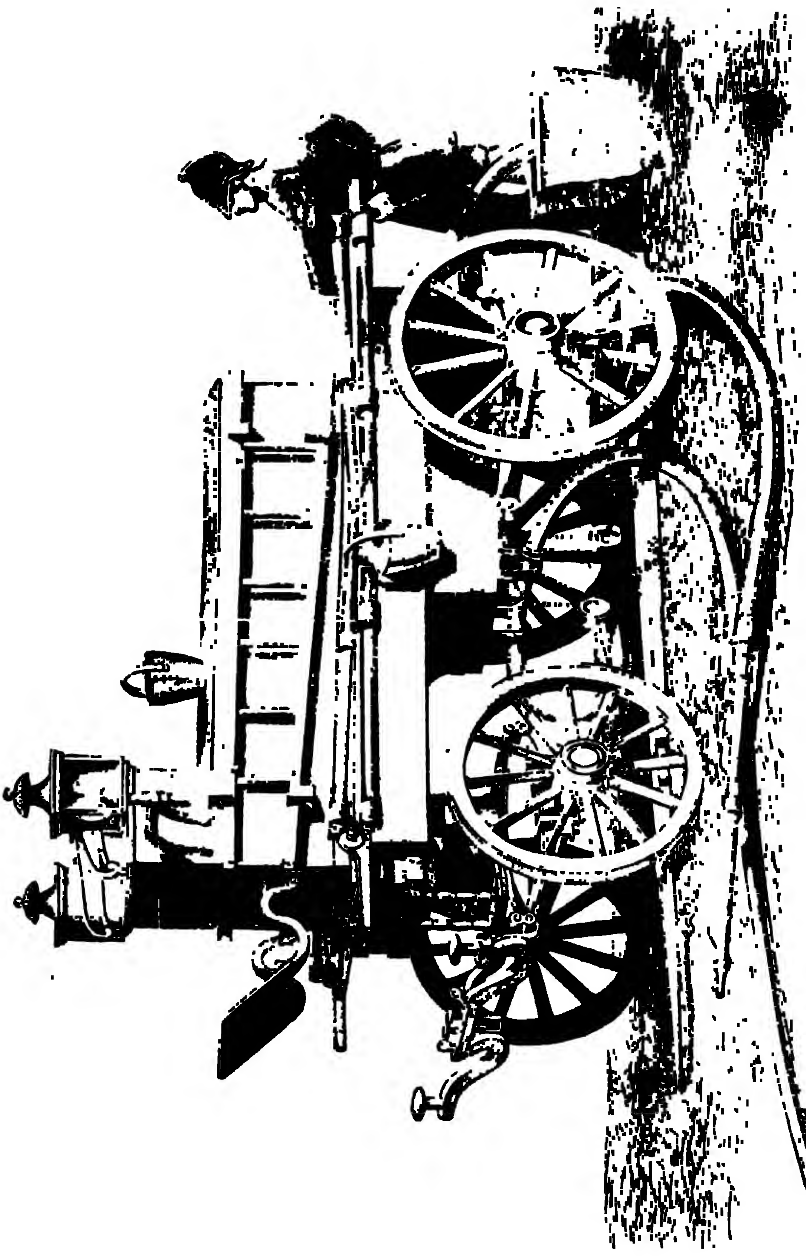


Fig. 39.

drawings may be shaded by means of lines, as in the examples we have given, thus imitating the manner in which engravers give the desired shade. When this is carefully executed in fine ink lines, regularly drawn, the drawing has a fine effect when finished, accurately tint, and washing the outside line of this with a brush moistened in pure water, until the colour gradually blends into the tint of the surrounding paper. The depth of tint towards the outside part should be gradually got up to the desired point by repeated

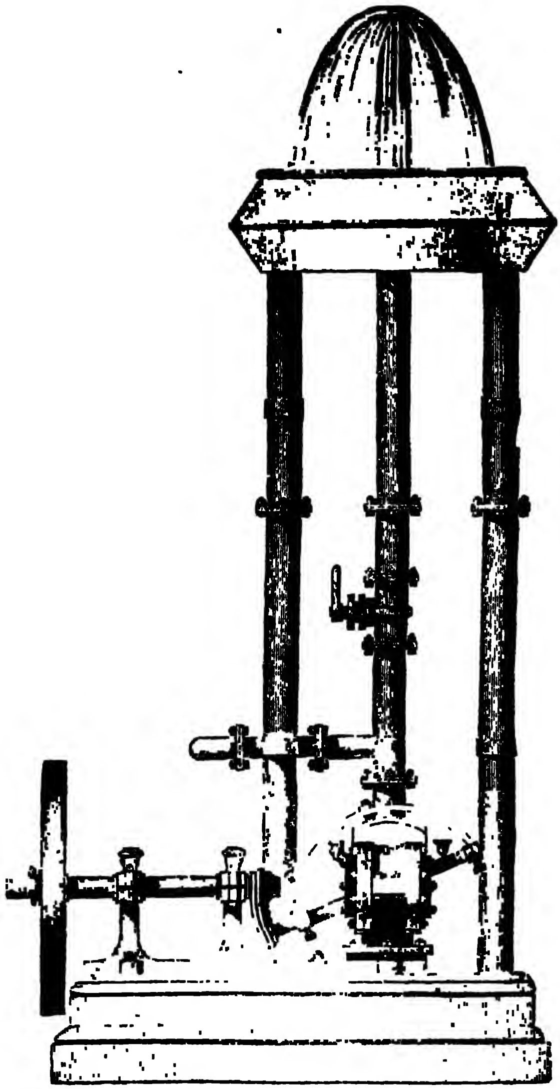


Fig 6..

presenting the appearance of roundness in some portions and flatness in others, according as the subject requires. When this method is considered too tedious, the shades may be put in with Indian ink and a camel-hair brush, the appearance of roundness being imparted by first putting in a part of uniform depth in operations, the colour used being of a light shade. The addition of a little blue imparts a softness to the Indian ink, which is agreeable to the eye. Cast-iron surfaces are represented by a bluish grey tint, malleable iron by a light blue; brass surfaces by a faint yellow, brick by a reddish yellow, faintly mottled with

a shade darker of the same colour; stones by a faint yellow, with horizontal streaks of a darker tint; wood by yellow, with vertical streaks of a faint black; water by faint blue, with horizontal streaks or lines of a faint black: these look best when put in carefully with the pen and square, as in the diagram in fig. 59. These are the principal shades of colours required. The colours generally required are Indian ink, gamboge, Prussian blue, Indian red, lake, and sepia

Fig. 59.

MECHANICS, *me-kăn'-iks* (Gr. *mechina*, a machine), a term applied in Nat. Phil. to one of the most important branches of practical mathematics. Mechanics comprehend the laws of motion, and the action of bodies on one another, to give a simple definition of the word. The term, as originally understood, embraced only the application of machinery; but in the present day, mechanics have been extended to comprehend the theory as well as practice of motion and equilibrium, both with and without the aid of machinery. As this branch of mathematics has much to do with the spread of civilization and the march of improvement, it may be as well to give a slight [illegible] of the rise and early history of the science. [illegible] remnants left us of the customs and exploits of the ancients, there can be no doubt that mechanics and mechanical powers were known many years prior to the birth of Christ. The stupendous pyramids of Egypt are striking evidences of the wonderful mechanical aids which the Egyptians must have been acquainted with, powers so vast, that even in the present day, with our amount of theoretical and practical knowledge, they could not be equalled, much less eclipsed. Aristotle is the first author about whom we have any proof of having written on mathematics, and he describes the simple powers of forces clearly, but somewhat erroneously. The first great mechanist is, however, undoubtedly Archimedes, and he did much, not only for geometry, but also for hydrostatics, of which he discovered and explained the general principles. Archimedes also discovered the centre of gravity (*see* GRAVITATION), and many useful and [illegible] machines which have not descended to our [illegible]. Water-mills are the oldest of mechanical inventions that have come down to us from the ancients, although hand-mills for grinding corn were well known to the Romans. The inclined plane (*see* article on the subject) was invented by Cardan. Simon Stevens, of Bruges, discovered and applied the theory of the parallelogram of forces; and the centre of gravity, as applied to solid bodies, was modelled, *in extenso*, from the early theory of Archimedes, by Lucas Valerius. Galileo was the first modern mathematician who did much for mechanics, for, under his hands, that science assumed perfectly different proportions from what it had done before. Toricelli, his pupil, further enlarged the theories which Galileo had started. The names of Pepin, the marquis of Worcester, Huygens, Wallis, and Wren, may likewise be added as illustrating mechanics in the 17th century. One of the greatest inducements, however, to the prosecution of this study was the publication of Newton's "Principia" (*see* PRINCIPIA). The steam-engine may be said to be the greatest of discoveries which have been made in this path, and a full description will be found given of it under articles headed LOCOMOTIVE ENGINE and STEAM-ENGINE. Euler's treatise on mechanics is one of the best works on the subject extant, and the student would do well likewise to consult Lagrange's "Mécanique analytique," and also Wood's, Whewell's, and Moseley's works. According to an excellent article on the subject in the "Encyclopædia Britannica," the theory of mechanics properly comprehends — 1. dynamics; 2. the motion of projectiles; 3. the theory of simple machines, or the mechanical forces; 4. the theory of compound machines, and their maximum effects; 5. the doctrine of the centre of gravity; 6. the doctrine of the centre of oscillation, gyration, &c.; 7. the collision of bodies; 8. the theory of rotation; 9. the theory of torsion; 10. the strength of materials; 11. and lastly, the equilibrium of arches and domes. The elementary machines, or mechanical powers, properly speaking, are six in number, and may be thus enumerated:—the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw; all of which will be found duly described under their usual appellations. (*See* LEVER, INCLINED PLANE, &c. &c.) Under the articles STATICS, DYNAMICS, HYDRODYNAMICS, and so on, the description of the elements of mechanics will be found fully given, and consequently they need not be treated on in the present article, which only has for its object the uniting of the several component parts of this branch of natural philosphy under one head.

MECHANICS' INSTITUTES is the name given to certain establishments which have been instituted in most of our larger towns for affording instruction to the working classes. The first idea of them is attributed to Dr. Birkbeck, who, in the year 1800, delivered a course of lectures on natural philosophy to working men in Glasgow. It was not, however, till about twenty years later that mechanics' institutions came to be established; and for a time they were very popular, and almost every town of 8,000 or 10,000 inhabitants came to have its mechanics' institute. Short courses of lectures on various popular subjects, as chemistry, natural philosophy, botany, political economy, &c., were [illegible]. In some cases reading-rooms and libraries were attached, and classes for English grammar, arithmetic, French, &c., established. They are supported partly by subscription and partly by contributions of the members. For some reason or other, however, mechanics' institutions have not been so successful as might have been expected; many of them had to be given up, and others were obliged more or less to alter their original intention and become more popular. As a general rule, it will be found that working men do not care to attend courses of lectures on any subject, especially on one that they cannot turn immediately or directly to account. After two or three lectures, the interest begins to flag. Wherever, then, a special subject is taken up, it ought to be exhausted in two or three lectures, and particularly the subject ought to be of an interesting and popular character; as accounts of men and places, travels, readings from popular [illegible], and occasional concerts. Reading-rooms and [illegible] in connection with mechanics' institutes are generally found to be well appreciated by working men.

MEDALLION, *me-dal'-le-on*, is a term applied to those larger medals which, if gold, exceed the *aureus* in size; if silver, the *denarius*, and if copper, the first or large brass. There have been many discussions among antiquaries as to the purposes for which medallions were designed; they are generally, however, supposed to be struck, like the medals of our own time, to commemorate some important event. Yet there are circumstances connected with them which render it not at all improbable that they were intended for circulation as money. They are not very numerous. Those of Greece, or those struck in the Grecian empire, are more common than those of Rome, but are of inferior workmanship. There exist in the present day a gold medallion of Augustus and one of Domitian; but few, in any metal, are found of the eras of Adrian and Antonine: those of brass are the largest, several being many inches in diameter. Impressions of both medals and medallions can easily be taken by pouring a little isinglass, previously melted in brandy, over the coin to be copied, and letting the solution spread over the whole surface. After standing a day or two, it will be quite hard, and on being taken off, will be found to contain a clean impression. The subjects COINS and MEDALS are so bound up together, that they will be found more scientifically described under the article NUMISMATICS (which *see*).—Ref. *Encyclopædia Britannica*, art. Numismatics; also *The Popular Encyclopædia*.

MEDALS, *med'-als* (from the Gr. *metallon*, metal), are those coins belonging to the study of Numismatics (which *see*), that are cast on some especial occasion to celebrate some important or remarkable event or personage; the first, strictly speaking, medals of antiquity being undoubtedly the medallions of the Romans.

The greatest difference that exists between the medals of ancient and modern times is owing to the fact that those of the later period have often portraits of illustrious personages who are not of regal origin, while those of the former never bear any but royal or imperial celebrities. The study of this branch of science and art is indispensable to archæology, and indeed to a thorough acquaintance with the fine arts. Medals indicate the names of provinces and cities, while determining their position, and they also present pictures of many places celebrated in history. They also fix the period of events, determine occasionally their character, and at the same time enable us to trace the different races of sovereigns who at various times have governed particular parts of the world. They also show us the different metallurgical processes, they enable us to discover the various alloys, the mode of gilding and plating practised by the ancients, the metals which they used, and their weights and measures, their different modes of reckoning, the names, titles, and orders of their various magistrates and princes, while also giving us their portraits; their different characters, modes of worship, with all their attributes and ceremonies, are likewise disclosed, and in fact everything that pertains particularly to civil, military, and religious usages. The ancient medals were either struck or cast; some, however, were first cast and then struck. Medals have two sides; the obverse side (*pars adversa, antica, l'avers*), which contains a portrait of the person in whose honour it was struck, or other figures relating to him. This portrait consists either of the head alone, or the bust, or of a half or full length figure. The reverse of the medal (*pars adversa, posticu, le revers*) contains mythological, allegorical, or other figures. The words which are around the border form what is termed the *legend*, while those in the centre are the *inscription*. Of all medals those from Egypt are the most ancient; and next to these rank those of Greece, the latter far surpassing the former in beauty of design and clearness of execution. Those of ancient Rome are extremely beautiful, the engraving being fine, the taste unexceptionable, and the invention simple. These latter are divided into two classes,—consular and imperial. Of these the former are the most ancient, for the copper and silver ones do not go further back than the 484th year of the Roman period, while those of gold do [illegible] extend further back than to the year 546. The [illegible]perial medals first commenced under Julius Cæsar, and continued until the year A.D. 260, the lower empire containing a space of 1200 years, ending with the capture of Constantinople. In the arrangement of medals, it is observed, in an article in the "Encyclopædia Britannica," that a general uniformity is no slight gain, and may reconcile us to partial defects. These defects must be remedied, in large collectio[illegible] by the use of cross references from one cabinet [illegible] another, and by the formation of independent series to illustrate the general one. The latter suggestion is well worthy of careful consideration. A series illustrative of Greek art, and another of Roman art, might be formed. A series of portraits, and another of groups, would be equally valuable. Others might be made to show the changes of states, by the weights and values of the materials used in their [illegible], while illustrating the history of the particular country or city in question.

Medicago, *med-e-kai'-go* (said to be from *medike*, a name given by Dioscorides to a Median grass), in Bot., a gen. of papilionaceous *Leguminosæ*, including many valuable fodder-plants. The name of *Lucerne* is commonly applied to species and varieties cultivated in this country.

Medical Jurisprudence is that department of science in which medical knowledge is called in to the aid of legislation, and consists in the application of the principles of medical science to the administration of justice and the preservation of the public health. Even as early as the institution of the Mosaic economy, we find traces of a medical jurisprudence, when the judges were enjoined to consult the priests, who were then the only physicians, on the modes of distinguishing leprosy from other diseases, &c. In ancient Greece, though the principles of medical science were successfully cultivated, they seem to have been little employed in legislation. In the Justinian code, we find very obvious traces of the relation between medicine and law. But the origin of medical jurisprudence as a science cannot be considered to date farther back than the middle of the 16th century, when the celebrated Carolinian Criminal Code was published in Germany. This code of Charles V. enjoined the magistrate, in all cases of doubt respecting asserted pregnancy, infanticide, the means of homicide, and other cases of death by violence, to consult the opinions of living medical men; for, singularly enough, the Justinian code referred the decision of medical questions, not to living witnesses, but "the authority of the learned Hippocrates." During the latter part of the 16th and the earlier part of the 17th century, medical jurisprudence made marked progress. Ambrose Paré, the first writer on this subject in France, wrote on monstrous births and simulated diseases; in 1602, Fortunatus Fidelis published, at Palermo, his system of legal medicine, and about twenty years later, Paulus Zacchias commenced the publication of his celebrated "Quæstiones Medico-legales," which, for completeness and learning, was the first great work on the subject. In France, in 1609, Henry IV. authorized the appointment of two persons skilled in medicine and surgery, in every considerable town, to make examinations and report in all cases of [wo]unded or murdered persons, and from the middle to the end of the 17th century, various decrees of the parliament of Paris were directed to the improvement of legal medicine. Bartholin, Swammerdam, and Jan Schreyer, are distinguished names in this science in the latter half of the 17th century. About the middle of that century, Michaelis gave the first course of lectures on it in the university of Leipsig. These were soon after followed by the lectures of the celebrated Bohn. The 18th century teems with important works on [t]his science, among the more important of which may be mentioned the "Pandectæ Medico-legales," of Valentine (1722), "Systema Jurisprudentiæ Medicæ," of Alberti (6 vols., Halle, 1725-47), "Institutiones Medicinæ Legalis et Forensis," of Teichmeyer; "Elementa," of Plenck (1781); "Systema," of Metzger, (1795), and the "Collectio Opusculorum," of Schlegel. The celebrated lectures of Haller were published after his death, in 1782-81, and just before the close of the century, Foderé published his "Les Lois éclairées par les Sciences physiques." Among the other distinguished names in this science during the period are Plouequet, Daniel, Portal, Camper, Loder, Antoine Louis, and Chaussier. The short elementary treatise of Dr Samuel Farr (1788) may be said to be the only work that had yet appeared in the English language. The most important accessions to medical jurisprudence during the present century are derived from our increased knowledge of the nature of mental disease and the nature and effects of poison, with the means of detecting them. In 1813, Foderé issued a new and much enlarged edition of his treatise, and in the following year appeared the valuable work of Orfila on toxicology ("Toxicologue générale"), followed, five years, later by his "Leçons de Médecine légale." Devergier, Briand, Capuron, Biessy, Esquirol, and Marc, are authors of learned treatises, or of dissertations on single subjects. Among the Germans, Schmidmuller, Rose, Willberg, Gmelin, Remen, Bernt, Henke, and many others, have made various and valuable additions to the science. The first respectable English work on this subject was by Dr. Male in 1816, entitled "Epitome of Juridical or Forensic Medicine for the Use of Medical Men, Coroners, &c." In 1819, Dr. Haslam published his "Medical Jurisprudence as it relates to Insanity," and Dr. Gordon Smith his "Principles of Forensic Medicine," in 1821. Two years later appeared the formal and elaborate work of Messrs. Paris and Fonblanque (a lawyer and a physician), in 3 volumes 8vo. The works of Dr. Christison on poisons, of Drs. Beck, Traill, and Taylor, may be referred to, as in their latest editions being the most able and complete treatises in our language. Medical jurisprudence is usually divided into forensic medicine and medical police; the first comprising—(1) questions affecting the

(2) what relates to the health of men collected in communities. Under the head of questions affecting the civil or social rights of individuals come to be considered —(*a*) the development of the human frame, with the periods of growth, maturity, and decay; (*b*) duration of human life; (*c*) personal identity; (*d*) marriage, with the physical circumstances affecting its legality or which may justify divorce; (*e*) impotence and sterility, with the causes and marks of; (*f*) pregnancy, its signs and limits; (*g*) parturition; (*h*) monsters and hermaphrodites; (*j*) paternity and affiliation; (*k*) presumptions of survivorship, as where a mother and new-born infant are found dead together, it is often of importance to find out which survived the other, (*l*) mental alienation, and the means of distinguishing between real and affected cases of insanity, (*m*) the rights of the deaf and dumb, (*n*) maladies exempting from public duties; and (*o*) simulated diseases. Under injuries to property are included—(*a*) nuisances from manufactories, &c.; (*b*) arson, (*c*) forgery and falsification of documents, (*d*) coining of false money. Injuries against the person include—(*a*) defloration; (*b*) rape; (*c*) mutilation; (*d*) criminal abortion; (*e*) infanticide; (*f*) homicide, [illegible] g, hanging, strangling, &c; (*g*) death [illegible], (*h*) death from extremes of temperature; (*i*) wounds, (*k*) toxicology, comprising a knowledge of the various kinds of poisons, their action upon the human body, and the means of their detection. In the second department of the science, or medical police, the circumstances affecting the health of individuals are—(*a*) cleanliness, (*b*) aliment; (*c*) the regulation of apothecaries' shops, (*d*) clothing; (*e*) temperance; (*f*) exercise; (*g*) prostitution; (*h*) celibacy and marriage; (*i*) lactation and care of offspring; (*k*) effects of profession and trade upon health. The circumstances affecting the health of communities are—(*a*) climate, (*b*) the sites of towns and habitations; (*c*) drains and sewers; (*d*) paving of streets and care of public ways; (*e*) cemeteries; (*f*) hospitals; (*g*) schools, (*h*) prisons; (*i*) lazarettos and quarantine establishments, (*k*) punishments.—These various subjects will be found treated of under their respective names in other parts of this work.—*Ref.* the several works on *Medical Jurisprudence* by Drs. Beck, Traill, and Taylor.

MEDICINE, *med'-e-sin* (Lat. *medicina*), is the art and science of curing disease. From the accidents and infirmities to which human nature is liable, we may readily suppose this art to be almost as old as the human race. Even among the most rude and barbarous people of the present day, we find some kind of appliances to wounds and injuries, and some means adopted to overcome internal disease. In the earliest ages of civilization, we find medicine in the hands of the priests, perhaps from the idea that disease is occasioned by the anger of the gods; and hence its treatment was accompanied with many superstitious rites. The Egyptians must have been possessed of a considerable knowledge of the human body and the nature of disease, from the high degree of perfection to which they had brought the art of embalming; and hence, probably, Moses, who was learned in all the knowledge of the Egyptians, may have acquired that practical knowledge of the nature of disease which appears in his writings. In the Odyssey of Homer, mention is made of a drug "that frees men from grief and from anger, and causes oblivion of all ills." The early history of medicine in Greece is involved in obscurity, but it must have made considerable progress before the time of Hippocrates (born about B.C. 460), who collected the scattered knowledge of his time and added to it by his own genius and observation. The improvements which he made in medicine appear to have been so considerable that for many centuries his successors were content to follow him in reverential imitation. The great merit of Hippocrates lies in his descriptions of disease; and, bearing in mind the limited scope of his inquiries, we cannot but admire the sagacity of his observations. Soon after its foundation, Alexandria became the centre of the science and learning of the time, and medicine, in particular, was assiduously cultivated, and a knowledge of the human body was acquired by dissection, particularly by Herophilus and Erasistratus; for up to that time the knowledge of the human body had been drawn by analogy from dissections of the lower animals. For some centuries after this time, physicians were divided into two classes,—the Dogmatics, or followers of Hippocrates, who maintained that, to treat disease, we must be acquainted with its occult as well as exciting causes, and with the natural actions of the human body; while the empirics, on the other hand, held that such knowledge was unattainable and unnecessary, and that experience ought to be the sole guide in practice. During the early period of the Roman empire, medical science appears to have been but little cultivated. The first physician of note who practised at Rome was Asclepiades of Bithynia, who was a contemporary of Cicero. His pupil, Themison of Laodicea, was the founder of the sect of the Methodists, who were intermediate between the Dogmatists and Empirics; and while the Dogmatists regarded the fluids as the seat of disease, the Methodists believed that the solids were first affected, and that the derangement of the fluids was but secondary. The most distinguished succeeding physicians of the Methodists were Soranus and C. Aurelianus. Celsus, who flourished probably towards the end of the 1st century, has, in his work *de Medicinâ*, given us a [illegible] of all that was known on the subject up to his [illegible]. [illegible] work takes almost equal rank with the Hippocratic writings, and shows the great progress which medicine had made through the labours of the anatomists of Alexandria. He treats of most of the great operations of surgery, of wounds in the intestines, injuries of the brain, the use of ligatures, &c. Aretæus of Cappadocia, who flourished probably in the early part of the 2nd century, has left a treatise on diseases, which is one of the most valuable of ancient medical works, and is remarkable for its accuracy and spirited description. The next individual of note in medical science is Galen, a native of Pergamus, who came to Rome at the invitation of the emperor Marcus Aurelius, about A.D. 165. Having mastered all the theories and knowledge of his times, he gave his talents and labour to constructing a summary of them. His works are therefore very voluminous, and constitute a perfect encyclopædia of the medical science of the day. For many centuries after his time physicians were content with rigidly following him. His writings were regarded as the ultimate authority on all points; and everything that seemed opposed to them was at once rejected. The only writers of note were Oribasius (A.D. 360), Aetius (525), Alexander of Tralles, Procopius (540), and Paulus Ægineta (600—640). The last of these, a learned and talented physician, was a voluminous compiler, and may be said to have brought the [illegible] of medicine in the Eastern empire down [illegible] his own time. From that time down to the 12th century, the Arabians were the only people among whom medicine made any progress. On the taking of Alexandria, they became acquainted with the writings of Hippocrates, Galen, and others, whose works were soon after translated into Arabic, and diligently studied. One of the most distinguished of the Arabian school was Rhazes, who flourished at Bagdad towards the end of the 9th century. He was [illegible]minous writer; but his works are chiefly compilations from the Greeks, though he also wrote some [illegible]ginal treatises, particularly one on smallpox and [illegible]asles. But the most distinguished author of this school was Avicenna (born 980), who has been styled the Galen of the Arabian empire. His great work, the [illegible]on," became the text-book of Arabian commentators and teachers during the 12th and 13th centuries. Avenzoar and Averrhoes, who flourished in Spain in the 12th century, were also distinguished members of the Arabian school. During the rest of the middle ages there existed a sort of Galeno-Arabian science of medicine, mostly fostered by ignorant monks, and suffering, perhaps more than any other science, from every superstition and misconception of nature. Two of the principal medical authors were Albertus Magnus and Roger Bacon, the one a prelate in high favour with the papacy, the other a Franciscan monk. In the 12th century the medical school of Salerno was established, and followed by several others; and in the beginning of the 14th century, the study of practical anatomy was restored by Mondini at Bologna. With the fall of Constantinople in 1453, and the consequent

dispersion of a number of learned men, who established themselves as teachers in Italy and other parts, and thus gave a new impulse to the cultivation of Greek medical science and literature, the study of Hippocrates was revived, and faith in Galen began to be shaken. In the beginning of the 16th century medical science in England derived great assistance from Linacre, who gave lectures on physic at Oxford, and founded the College of Physicians. With Paracelsus, in the 16th century, began the sect of chemical physicians, who, contemning the learning of the Galenists, devoted themselves to the study of chemistry, maintaining that the operations of the human body are subject to the same laws as govern inorganic matter. In the 17th century, a number of very distinguished names appear in medicine; as Harvey, who discovered the circulation of the blood, Asellius, Sydenham, Malpighi, Riolan, Pecquet, Bartholin, Fabricius, Sylvius, Willis, Fallopius. The beginning of the 18th century was characterized by the establishment of clinical medicine, or bedside teaching on a systematic plan, by Boerhaave, who was appointed lecturer on the theory of medicine at Leyden in 1701, and four years later became physician to St Augustine's hospital, when he commenced a systematic course of clinical lectures. He was, besides, a man of extensive erudition, and brought order and system out of the vast mass of materials that had been accumulating during the preceding century. He likewise advanced practical medicine in all its departments. Among his pupils were Van Sureten and Haller, the former of whom followed his master too closely to add much of real value to the science; but the latter greatly improved it, particularly in the department of physiology. In England, William and John Hunter laid the foundation of the English school of physiology. Dr. Cullen, of Edinburgh, with his varied knowledge and great original powers, rendered eminent service in systematizing the study of practical medicine. In the present century medical knowledge has made great advances. A much more minute and accurate knowledge of the human body has been obtained, the nature of many of its vital processes has come to be understood; and the characteristics of the different diseases, and the means of counteracting controlling them, are much better known. The vario[illegible] branches into which medicine is now commonly [illegible]vided are, *Anatomy*, or a knowledge of the structure of the human body, including *histology*, which treats of the minute structures of parts discernible only by the microscope; *Practical Anatomy*, which applies a knowledge of structure to a right performance of the operations of surgery, and *Pathological Anatomy*, which points out the aberrations from the normal or healthy structure of the organs or tissues of the human body; *Physiology*, or a knowledge of the vital actions; *Pathology*, comprising the nature, cause, and cure of disease; *Nosology*, which treats of the various kinds of diseases, and tries to arrange them systematically; *Surgery*, treating of mechanical injuries, and the modes of relieving diseases and derangements by mechanical means; *Obstetrics*, or *Midwifery*, dealing with the modes of facilitating delivery, and the diseases of children; *Materia Medica*, or the science of medicines, their nature, composition, and effects, *Pharmacy*, or the preparation of medicines; *Therapeutics*, the application and administration of every kind of remedy; *Hygiene*, treating of the laws of [illegible] *Dietetics* [illegible] with the rules of diet; *Medical Jurisp[illegible]*, [illegible] application of the science of medicine to the administration of law; *Clinical Medicine*, or the [illegible] communicated at the bedside of the patient, *Psych[illegible]logical Medicine*, or the nature and [illegible] of mental diseases. Intimately connected with [illegible] the sciences of *Natural Philosophy*, *Chemistry*, *Zoology*, *Botany*, *Mineralogy*, *Meteorology*, &c.

Medley, *med'-le* (Ang.-Sax.), in the melopœia of the ancients, was that part which consisted of the proper intermixture of the modes and genera called by the Greeks *agoge*. At the present day, the word medley is employed to designate a numerous assemblage of the detached parts of different popular songs, so arranged that the latter words of the sentence or tune of one song connect with the beginning of another.

Medusa, *me-du'-sa*, or **Gorgon-Heads** (*Ophiuridæ*), a species of marine animals belonging to the class *Echinodermata*, and commonly known by the appellation of lizard-tailed star-fishes. The *gorgon-heads* have all an orbicular depressed body, with five arms, which are cylindrical, jointed, and very flexible; these arms are often extremely long, and subdivided into branches; they are covered with scales, somewhat like the tails of serpents, and are very fragile. Their means of progression are consequently very different from those of the true star-fishes; as, when they move, they employ the two arms that are nearest the point to which they wish to proceed; and the one also farthest from that point. The two in front pull the animal along by means of hooks at their ends, while the one behind is pushed into the sand, and is employed to shove it on. The *Ophiuridæ* live nearly exclusively on sandy shores, and on the approach of any danger they hide themselves in the mud; like several others, they quickly recover the loss of their arms, as they grow again in a few days. There are numerous varieties of this family, of which the one just described is the type.

Meerschaum, *meer'-shaum* (Ger., foam of the sea), a peculiar silicated magnesian mineral found in several parts of Europe, but mostly in Greece and Turkey. In the last-mentioned country it is extensively used as fullers' earth; but in Austria and Germany it is adapted to the manufacture of tobacco-pipes, which are prepared for sale by being first soaked in tallow, afterwards in wax, and being finally polished with shave-grass. The true meerschaum always turns from a pure milk-white to a brownish-black colour when smoked for some time, by reason of the influence on it of the tobacco-oil; and to connoisseurs this is a true criterion between true and false meerschaum, the latter of which [illegible] manufactured.

Megatherium, *me[illegible]-the'-re-um* (Gr. *megas*, great, and *therion*, beast), a name given by Cuvier to the typical representative of a series of endentate quadrupeds, the largest and most gigantic of terrestrial mammals. Two specimens of this animal have been found in America, the one termed the *Megatherium Cuvieri*, and the other the *M. Jeffersoni*,—the latter being first described by President Jefferson, as may be seen by the "Transactions of the American Philological Society" (iv. 246). The haunches of the megatherium named after Cuvier must have exceeded five feet in width, while its body was about twelve feet long and eight high. Its feet were a yard in length, and terminated in formidable compressed claws of great size; its tail was also of great length and thickness, exceeding the size of that member in either living or extinct quadrupeds. The head of the megatherium was of comparatively small size, and the cranium presents many of the peculiarities of the sloth; from which circumstances it has been termed the *giant sloth*. Not much—indeed, to say truly, nothing—is known of the habits of this immense animal, except that it must have, according to the authority of eminent naturalists, possessed a scaly armour; whence it must also have been closely allied to the armadillo family.

Melaleuca, *mel-al-lu'-ka* (Gr. *melas*, black; *leukos*, white, because the trunk is black and the branches white), in Bot., a gen. of the nat. ord. *Myrtaceæ*. The species *M. minor*, or *Cajeputi*, is a small tree of the Molucca Islands. Its leaves, when allowed to stand so as to undergo a species of fermentation, and then distilled with water, yield a volatile oil of a limpid nature and a light-green colour. This product, which is called cajeput-oil, was formerly much employed as a remedy in cholera, but without any success. It has been used internally as a diffusible stimulant, antispasmodic, and diaphoretic, and externally, when mixed with olive-oil, as a stimulant embrocation. It has the property of dissolving caoutchouc. In Australia the leaves of the species *M. scoparia* and *genistifolia* are used as substitutes for tea.

Melanosporeæ. (*See* Algæ.)

Melanthaceæ, or **Colchicaceæ**, *mel-än-thai'-se-e*, *kol-tshi-käi'-se-e* (Gr. *melas*, black, and *anthos*, a flower), in Bot., the Colchicum fam., a nat. ord. of *Monocotyledones*, sub-class *Petaloideæ*. Herbs with bulbs or corms, tuberous or fibrous roots. Flowers regular, usually hermaphrodite, rarely unisexual; perianth inferior, white, green, or purple, petaloid, 6-parted or 6-leaved; stamens 6; anthers extrorse; ovary supe-

rior or nearly so, 3-celled; style 3-parted. Fruit 3-celled, 3-valved, with septicidal, or rarely loculicidal dehiscence. Seeds with a membranous testa; embryo minute, in fleshy albumen. The plants of the order are generally diffused, but most abundant in Europe, North America, and Northern Asia. There are 31 genera, which include 130 species. They are generally poisonous, owing to the presence of powerful alkaloids. In proper doses, however, several are valuable medicines. (*See* VERATRUM, COLCHICUM.)

MELASTOMACEÆ, *mel-ds-to-mai'-se-e*, Gr. *melas*, black; *stoma*, the mouth; the black berries of some of the species are eaten by children, whose mouths they stain black), in Bot., the *Melastoma* fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciforæ*. Trees, shrubs, or herbs, with opposite leaves, almost always ribbed and dotless. Calyx 4-, 5-, or 6-lobed, more or less adherent to the ovary, imbricated; petals equal in number to the divisions of the calyx, twisted in æstivation; stamens equal in number, or twice as many as the petals, filaments curved downwards in æstivation; anthers long, 2-celled, curiously beaked, usually dehiscing by two pores at the apex, or sometimes longitudinally, in æstivation lying in spaces between the ovary and sides of the calyx; ovary more or less adherent, many-celled. Fruit either dry, distinct from the calyx, and dehiscent, or succulent, united to the calyx, and indehiscent Seeds very numerous, minute, exalbuminous. The plants of this order are principally natives of tropical regions, but a few are also extra-tropical. They are generally characterized by astringency. Many produce edible fruits, and some are used for dyeing black and other colours. A number of species are cultivated in this country on account of the beauty of their flowers.

MELIACEÆ, *me-le-ai'-se-e* (from Gr *meli*, honey, from its aromatic flavour), in Bot, the *Melia* fam., a nat ord of *Dicotyledones*, sub-class *Thalamifloræ*, having the following essential characters.—Trees or shrubs with usually alternate, simple, or pinnate exstipulate leaves. Flowers hypogynous and generally symmetrical; calyx and corolla with 3, 4, or 5 divisions, stamens twice as many as the petals, distinctly monadelphous; anthers sessile; disc hypogynous and often surrounding the ovary like a cup; ovary 2—5, rarely 10- or 12-celled, style 1; ovules 1, 2, or 4, attached to axile placentas. Fruit succulent or capsular, with loculicidal dehiscence. Seeds few, not winged; albumen fleshy, or altogether absent. The order is very nearly allied to *Cedrelaceæ*, the Mahogany family. There are 33 genera and 150 species, found more or less in all tropical regions Some produce edible fruits, others have valuable oil-yielding seeds, and some are remarkable for their medicinal properties, which in general are bitter, tonic, and astringent, but in some cases purgative and emetic The most interesting member of the order is *Melia Azedarachta*, the *Neem-tree* or *Pride of India*, or, as it is sometimes called, the *Margosa tree*. It possesses febrifugal properties. The pericarp yields, by expression, a fixed oil, which is used for burning The tree also yields a kind of toddy, which is employed as a stomachic.

MELIANTHUS, *mel-e-ăn'-thus* (Lat *mel*, honey, *anthos*, a flower), in Bot., a gen of the nat ord. *Zygophyllaceæ*, or, according to the views of some botanists, the type of a distinct ord. termed *Melianthee*. The flowers of the species *M. major* contain much saccharine matter, which is extracted and used as food by the natives of the Cape of Good Hope, where the plant abounds.

MELILOTUS, *mel-e-lo'-tus* (from Lat *mel*, honey, and *lotus*; honey-lotus), in Bot, the Melilot, a gen. of papilionaceous *Leguminosæ*. The flowers and seeds of *M. officinalis*, and other species, possess a peculiar fragrance, which is due to the presence of *coumarine*. They are used to flavour *gruyère* and other kinds of cheese.

MELISSA, *mel-is'-să* (Gr. *melissa*, a bee), in Bot, a gen. of the nat. ord. *Labiatæ*. *M officinalis*, common balm, possesses mild stimulant properties, and its decoction is used as a diaphoretic in fevers, as an exhilarating drink in nervous affections, and as an emmenagogue. The bees obtain a great deal of honey from the balm.

MELOCACTUS, *me-lo-kăk'-tus* (Gr.), in Bot., the Melon-cactus, a gen. of the nat. ord. *Cactaceæ*. The fleshy stems of this genus have been likened to large green melons, to turbans, and to hedgehogs. In the dry districts of South America they are eaten by cattle on account of their juice.

MELODRAMA. (*See* DRAMA.)

MELODY, *mel'-o-de* (from Gr. *melos*, a song), a term synonymous in modern music with air, a succession of simple sounds so arranged as to produce a pleasing effect upon the ear. It may be defined as a series of sounds more fixed, and generally longer, than those of common speech, arranged with grace, and of proportionate lengths, such as the mind can easily measure and the voice express. Of the relative importance of melody and harmony it is useless to speak, as they may be said to generate into each other, the one being the selection of single sounds from a harmonic source, and the other a union of two melodies simultaneously heard. Thus they are closely connected and of equal importance, the one being necessary to the other. (*See* HARMONY.)

MELON. (*See* CUCUMIS and CUCURBITA.)

MEMORY, *mem'-o-re* (Lat. *memoria*, Gr. *mneme*), in Mental Phil., is one of the most important of all our faculties. It is obviously the great foundation of all mental improvement, being that which enables us to treasure up for future use the knowledge we acquire, and without which no advantage could be derived from the most enlarged experience. Memory, perhaps more than any other faculty of the mind, is dependent upon the physical condition of the body. We may smile as we read in the old writers on memory, of plasters and powders and perfumes for strengthening the memory; but even in the present day, Sir B. Brodie says that it is possible that, by accurate observation, the proper means may be discovered of preserving that temperament of the brain which is favourable to memory; all indicating a belief in the dependence of memory upon physical conditions. The term memory implies two things, namely, retention and reproduction—the capacity of retaining knowledge and the power of recalling it to our thoughts when we have occasion to use it. These vary greatly in different individuals, some having a good retention but a bad recollection; others a good recollection but a bad retention. Though apparently so different in character, yet we are inclined to regard them as the result of one principle,—that of association, the man of recollection having his ideas so connected that the one readily calls up the other; the man of retention having them so intermixed and interwoven that it is only after a time or by some lucky chance that the right idea comes up. Indeed, so far as retention is concerned, it is held by many philosophers that whatever has once been the object of consciousness is ever after retained, its being recollected or not depending entirely upon the laws of association. In support of this doctrine, we have numerous instances of persons recollecting, in the delirium of a fever, things which had long since been forgotten, or even speaking in a language—that of the early childhood—which had otherwise long passed from the mind. Not the least singular feature of memory is the way in which it is affected by certain diseases of the brain. Sometimes the patient loses the whole stock of his knowledge acquired previous to the disease, the faculty of acquiring and retaining new information remaining entire. Sometimes he loses his memory of words and retains that of things, or he may retain his memory of nouns and lose that of verbs, or *vice versâ*. But, perhaps, the most singular case—and it is not very uncommon—is when one language is taken entirely out of his retention without affecting the memory of others. Memory, then, as we have said, depends upon the association of ideas, by which one thought, feeling, or emotion tends to recall or reproduce another. In the article ASSOCIATION OF IDEAS (which *see*), we have attempted to refer the different laws of association to one,—that of contiguity; ideas that have been in the mind together, or in close succession, ever after manifesting a tendency to recall or reproduce one another. Hence it follows, as a general rule, that the closer two or more ideas are brought together in the mind, the more strongly will they be associated, and the greater will be their power of reproducing one another. Where any interval takes place between ideas which we wish to associate together, irrelevant ideas will be apt to intervene and

weaken their adhesion. Hence, the importance to memory of sound health and a mind free from anxieties. The objects of memory are either things external to us, or internal states and modes of consciousness. There are different kinds of memory,—as for figures, names, places, events, and so on; some persons being distinguished for one kind of memory, others for another. The circumstances which have a tendency to increase the retention or recollection of anything are chiefly vividness, repetition, and attention. Ideas that make a vivid impression on the mind are readily recalled, as also, on the same principle, those to which the attention has been specially directed. The longer an idea is before the mind, or the more frequently it is recalled, the better is it remembered. (*See* MNEMONICS.)

MENISPERMACEÆ, *men-e-sper-mai'-se-e* (Gr. *mene*, the moon; *sperma*, seed), in Bot., the Moon-seed fam., a nat. ord. of *Dicotyledones*, sub-class *Thalamifloræ*; consisting of trailing or climbing shrubs, with alternate, simple, and exstipulate leaves, and usually [illegible] flowers. The sepals, petals, stamens, and carp[illegible] a ternary arrangement. The carpels are distinct, and supported on a gynophore. The fruits are drupaceous, curved around a central placental process, and 1-celled. Seed solitary, curved; embryo curved, albumen absent, or small in amount. The plants of this order are chiefly found in the forests of the tropical regions of Asia and America: none occur in Europe. They are remarkable for their narcotic and bitter principles. (*See* ANAMIRTA, COCCULUS INDICUS.)

MENNONITES, *men'-non-ites*, the name applied to the Anabaptists of Holland after they had placed themselves under the leadership of a native of Friesland, named Menno, who engaged to abate the fanatic zeal of his new followers. (*See* ANABAPTISTS.)

MENSURATION, *men-su-rai'-shun* (Lat. *mensura*, measure), [illegible] science which treats on the measure[illegible] areas, and solidity of different figures or bodies. As mensuration, properly considered, embraces geometry and tr[illegible] subjects separate articles will [illegible] present paper will be only devote[illegible] of a few simple formulas which relate more particularly to arithmetical mensuration, if the science can be so designated. Any quantity is always measured by some other quantity of the same kind, of a known magnitude, called the *measuring unit*. Thus, for example, a line measured by a straight line of a known length, [illegible] 1 inch, 1 foot, 1 yard, and so on. In like manner [illegible] plane surface is measured by a *square*, of which the side is 1 inch, 1 link, 1 foot, &c.; and the number of such squares that any plane surface is found to contain is called the *area*, or *content*, of the surface in question. The area of a parallelogram, or rectangle (*see* GEOMETRY), is found by multiplying the height by the length. Thus if we want to find the area of a piece of wood 10 inches long and 5 wide, we multiply 5 by 10, and the content will be 50 *square* inches. In the mensuration of land, the unit of measure is generally the link, in order to render the result less intricate, by m[illegible] of the imperial chain. Thus if the content of a p[illegible] of ground 575 links long by 425 links broad is desired to be known, 575 is multiplied by 425, and the result is 244,375 links. But 100,000 square links are equivalent to an acre; and, consequently, dividing by that number, we find that the field contains 2·44375 acres, the decimal of which, on being reduced, will be found to contain 1 rood, 31 perches; therefore the field contains 2 acres, 1 rood, 31 perches. The area of a triangle is found by multiplying the base by half the perpendicular height, and the half of this product will be the area. The reason of this may be thus deduced:—The area of every parallelogram has been shown to be equal to its length multiplied by its breadth or height; and it is well known that every parallelogram is double a triangle of the same height or the same base; consequently, the area of a triangle is equal to half the product of its base and height. To find the area of any quadrilateral or four-sided figure, it is only necessary to divide it into two triangles, and by proceeding according to the rule last given, the result will be obtained. The area of a regular polygon is found by multiplying half the perimeter by the perpendicular, drawn from the centre to one of the sides, and the product will be the area of the polygon. The following table, which is usually given in works on this subject, will be found extremely useful, as it will save the complex calculation which would otherwise be required. In order to use it, multiply the square of a side of any regular polygon by the corresponding area in the table, and the product will be the area of the polygon in question.

Name of Polygon.	No. of Sides	One-half the angle of Polygon.	Area when the side is 1.	Perpendicular when the side is 1.
Equilateral Triangle	3	30°	0·4330127	0·2886751346
Square ..	4	45°	1·	0·5
Pentagon.....	5	54°	1·7204774	0·6881909603
Hexagon	6	60°	2·5980762	0·8660254038
Heptagon ..	7	64°$\frac{2}{7}$	3·6339124	1·0382606981
Octagon	8	67°$\frac{1}{2}$	4·8284271	1·2071067812
Nonagon	9	70°	6·1818242	1·3737387097
Decagon	10	72°	7·6942088	1·5388417686
Undecagon ..	11	73°$\frac{7}{11}$	9·3656399	1·7028436194
Dodecagon ..	12	75°	11·1961524	1·8660254038

For example,—what is the area of a pentagon whose side is 20 feet? We find from the table that the area of a pentagon whose side is 1 foot equals 1·7204774; therefore, by multiplying [illegible] by 20², or 400, we find the area [illegible] feet, the answer of the question. With regard to the circle, it has been shown in art. GEOMETRY, that the circumference is nearly equal to the diameter multiplied by 3·14159, &c.; and this must be remembered when we want to find the area or surface of a circle; the rule for obtaining which is as follows:—1. Multiply half the circumference by the radius, and the product will be the area. 2. Multiply the square of the diameter by ·7854, and the result will also be the area. 3. Multiply the square of the circumference by ·0795775, and the product will likewise be the area. By any of these rules the result arrived at will be true, and the area of the circle be obtained. The solid content of a rectangular figure is obtained by multiplying together its length, height, and breadth. Thus the solid content of a cube 3 feet [illegible], will be 3 × 4 × 2 = 24 solid feet. The [illegible] or cone is found by the mul[illegible] the area of the base into the perpen[illegible], and, taking one-third of the product. The area or surface of a sphere, or solid circle, is obtained by multiplying its circumference by its diameter: thus, the surface of a sphere whose diameter is 36 inches will be 36 × 3·1415926 = 4071·504 square inches. The total content of a globe or sphere is found by multiplying,—1. the cube of the diameter by 0·5236; or, 2. by multiplying the surface or area by one-sixth of the diameter. Thus, the solidity of a sphere whose diameter is 36 inches, and whose area in that case has been just shown to be 4071·504 square inches, would be 4071·504 × $\frac{36}{6}$ = 4071·504 × 6 = 24429·024 solid inches; or, by the first rule given, will be 36³ × ·523598, &c. = the same [illegible]. The method of measuring land, briefly touched upon at the commencement of this article, will be found fully given under the head of SURVEYING. In artificers' work there are many varieties of measurement used, although the usual calculations on the same are brought out by duodecimal multiplication. In order to find the solid content of squared timber, the mean breadth is multiplied by the mean thickness, and the product by the length; the result being the solid content. In round or unsquared timber, the content is obtained by multiplying the square of a quarter of the mean circumference, or of the mean quarter girth by the length. When a tree tapers regularly, according to writers on the subject, the girth may be taken at the middle for the mean girth, or it may be taken at both ends, and half the sum will be the mean girth. When a tree tapers irregularly, however, that is to say, when it is thick in some places and small in others, the girth may be taken at the ends and at equal intervals; in such cases, then, half the sum of the extreme girth, added to the intermediate girths, and then divided by the number of intervals between them, will be the *mean girth* required. When hard-wood trees are sold by the

cubic foot while growing, along with the body of the tree, only such of its branches as are 4½ inches or more in quarter girth are measured: if the purchaser has to pay for the cutting down of the trees, then he is generally allowed the wood from the branches below that size to meet his expenses. With reference to masonry, brick-work is measured by the *square rod* in England, containing 272¼ square feet. When the thickness of a wall contains the length of one brick and the breadth of another, that is to say, when it is about 14 inches, it is reckoned of standard thickness, and it is paid for by the rod in *square* measure. Painters' work is paid for by the square yard; but in mouldings and panellings of lines and shades, by the lineal foot. The measurement of casks, or of substances liable to excise duties, is termed [illegible]. The [illegible]tent of a cask is usually calculated b[illegible] of its length, and the diameter of its middle and end. The rule which is generally applie[illegible] — M[illegible] the length of the cask by the [illegible] bung and head diameters, and twice the middle diameter, and the whole product of these numbers by ·000172. For instance, suppose the gauge of a cask whose bung and head diameters are respectively 32 and 24, the middle diameter being 30 2, and the length of the cask being 40, is required. Then proceeding according to the above formula, 40 × [(12)² × (24)² × (2 × 30 2)] × ·000172 99 1 gallons, the answer sought. It would be impossible, within the narrow limits of the present article, to dilate at length upon the subject of mensuration, or even to furnish the reader with a comprehensive *précis* of the matter embraced under this designation. Those who really would know the science fully, must make it their especial study, and the reader will find a capital digest under the different articles on measures and mensuration, in Davidson's *Practical Mathematics* (*See*, also, GEOMETRY, SURVEYING, and TRIGONOMETRY.)

MENTHA, *men'-tha* (Lat.), in Bot., Mint, a gen. of the nat. ord. *Labiatæ*. Several species are used in medicine, and as sweet herbs for flavouring, &c. Three are officinal; namely, *M. viridis*, spearmint, *M. piperita*, peppermint; and *M. Pulegium*, pennyroyal. They all possess stimulant and carminative [illegible]

MENYANTHES, *men-e-an'-theez* (Gr. *men*, a [illegible] *anthos*, a flower, in allusion to the duration of the flowers), in Bot., a gen. of the nat. ord. *Gentianaceæ*. *M. trifoliata* is known commonly by the names *buck-bean*, *bog-bean*, or *marsh trefoil*. The leaves and rhizome are tonic and astringent, and in large doses cathartic and emetic. In some parts of Germany the plant is employed as a substitute for hops in beer.

MERCAPTAN, *mer-kap'-tan*, in Chem., a name given to a characteristic series of compounds derived from the alcohols by the substitution of sulphur for oxygen, of which ethylic mercaptan may be taken as the type.

Ethylic alcohol.	Ethylic mercaptan.
C_4H_5HO.	$C_4H_5S.HS$.

Ethylic mercaptan is a colourless transparent mobile fluid, with an intensely alliaceous smell, boiling at 96° and freezing at −8°. It is very inflammable, burning with a blue flame, it is sparingly soluble in water, but readily so in ether and alcohol. It forms compounds with the metals, corresponding closely to the hydrosulphates.

MERCHANTMAN, *mertsh'-ant-man*, in nautical phraseology, a term applied to a vessel employed in the transport of goods and articles of commerce, in contradistinction to a man-of-war, or vessel used for warlike purposes. Some of the best examples of this class of vessel are the liners and clippers employed in the East-Indian and Australian traffic, some of which, although sailing merely under canvas, have been known to make surprisingly rapid voyages to and from their respective ports. They are generally full-rigged ships, although many barques are employed. In coast trade and inter-colonial trade, as between the islands in the West Indies and the American continent, a lighter class of vessel is used,—generally a brigantine, of which a cut is given below. This craft, the brigantine, possesses eminently fast-sailing powers, and used to be much employed in the slave-trade, when that traffic was at the height of its infamy. Though the greatest amount of speed is sought to be obtained by building the bows and anterior parts of the vessel upon as fine lines as possible, yet, in the interior,—as, for instance, the hatchway and hold,—a large amount of stowage-room is obtained by making these last as roomy as is practicable, consistently with the tonnage of the ship.

MERCHANTMAN.

MERCURY, in Astron., the planet nearest the sun, from which it is distant about 36,170,000 miles, or [illegible] hat more than a third of the Earth's distance. Its mean sidereal revolution is performed in 87 96926 mean solar days. Mercury being an inferior planet, [illegible]ways appears in the neighbourhood of the sun, and is very seldom visible to the naked eye. During the interval which elapses between the disappearance of Mercury in the [illegible] and its reappearance [illegible] [illegible] [illegible]ck spot [illegible], which enters at the eastern margin of the disc, passes over the centre, and then vanishes. This spot is Mercury passing between the sun and the earth, and producing a veritable partial eclipse of the sun, which is called a *transit*. The mean distance of Mercury from the earth is about 29,500,000 miles. The apparent diameter of Mercury oscillates between 4·7″ and 12″, its real diameter is 3,062 miles, or a little more than a third of the diameter of the earth. Mercury is the densest of the planets, its density being 1·234, that of the earth being taken as unity. The light of Mercury is bright and twinkling; and when observed through a telescope with a high magnifying power, in the evening, regular phases may be observed. When it emerges from the rays of the sun, its form almost resembles a complete circle; as it recedes from the sun, the western part preserves its circular form, while the eastern region becomes elliptical; gradually it changes its form, and grows more hollow, till it finally plunges into the rays of the sun, resembling a very slender crescent. If the planet is observed on the day when it emerges in the [illegible] the rays of the twilight, and on the follo[illegible] [illegible] phenomena will be perceived, only occurring in a reverse order. From these facts it is affirmed that the planet derives the whole or greater part of its light from the sun, and that it revolves round that body in a curvilinear orbit.

MERCURY, *mer'-ku-re* (after the God), symbol Hg (hydrargyrum), equivalent 100, spec. grav. at −40° Fahr. 13·39, at 60° Fahr. 13·59. Mercury is one of the seven metals known to the ancients, and is, with the exception of bromine, the only element fluid at ordinary temperatures. It is found in nature in the form of cinnabar, or sulphide, in the clay-slate and red sandstone underlying the coal-measures. The most famous cinnabar-mines are those of Almaden in Spain, Idria in Transylvania, and New Almaden in California. It is also found in large quantities in China and Japan, and at Huancavelica, in Peru. The extraction of the metal from its ore is effected in two ways; either by

simple distillation, after having first burnt off the sulphur, or by mixing the cinnabar with iron filings or lime; in which case the sulphur forms a fixed sulphide with the iron or calcium, and the metal distils over nearly pure. The former process is pursued at Almaden; but great waste is common, owing to the imperfect method of condensation adopted. Mercury also occurs native as an amalgam with gold and silver, as an iodide, and as horn mercury, or subchloride. As imported into this country, it is nearly pure. The presence of foreign metals may be detected by shaking up a few drachms in a bottle, and allowing it to remain exposed to the air for a day or two. Should lead or any other metal be present, it may be detected by forming a film of oxide on the brilliant surface of the mercury. Any metallic impurity may be removed by digesting the metal in cold dilute nitric acid for several days. The economic uses of mercury are numerous. It is principally employed in extracting gold and silver from quartz and other matrices in which these metals occur. It forms with them an amalgam or pasty mass, from which it may be separated by distillation. The great increase it undergoes in volume between the freezing and boiling points of water renders it useful for thermometric purposes; and its great specific gravity has caused its employment in barometers. It is used as a developing agent in the daguerreotype. The chemist uses it instead of water, for collecting gases which would be absorbed by the latter fluid. With many metals it forms a pasty mass, termed an amalgam. This property is taken advantage of in the extraction of gold and silver from their matrices, as stated above; in the manufacture of mirrors and in gilding. An amalgam of two parts of zinc and four parts of mercury is used to give a partially metallic surface to the rubbers of frictional electric machines. It readily unites with zinc, and is rubbed on the plates of that metal in voltaic batteries to protect them from the action of the acids in which they are immersed. The amalgams formed with other metals are unimportant. Mercury freezes into a malleable mass at −40°, and boils at about 660° Fahr. It was supposed at one time to be non-volatile at ordinary temperatures, but the experiments of Karsten prove that even at 32° the volatilization of the metal [illegible] When pure it is not tarnished by [illegible] not decompose water at any temperature. Heated in a current of air to 700° or 800°, it becomes gradually converted into the red oxide. Hydrochloric acid does not act upon it, either hot or cold. Sulphuric acid does not affect it in the cold, but when heated, sulphurous acid gas is formed, which passes away, [illegible] the subsulphate of the metal beh[illegible] Strong nitric acid d[illegible]olves it readily, nitrate of mercury and deutoxide of nitrogen being formed. In combination with sulphur, it is used in the arts as the pigment vermilion. It is extensively employed in medicine as a cathartic and alterative. By trituration with saccharine or oleaginous substances, it admits of being minutely divided, and a small portion becomes oxidized, to which the properties of mercurial ointment appear to be owing.

MERCURY, CHLORIDES OF, in Chem.—Mercury forms two chlorides,—the subchloride, or calomel, Hg_2Cl, and the protochloride, $HgCl$, or corrosive sublimate. These two compounds are often mentioned in old textbooks as the protochloride and bichloride of mercury respectively. In fact, the popular name of corrosive sublimate is bichloride of mercury. Calomel is much used in medicine, and is generally prepared by triturating 13 parts of the metal with 17 of the chloride until no metallic globules are visible. The mixture is then sublimed, and the calomel is deposited in fibrous masses. The chloride or corrosive sublimate is made on a large scale by mixing two and a half parts of sulphate of mercury with one part of common salt and subliming in glass vessels. Corrosive sublimate is soluble in 16 parts of cold water; and in three of hot water its solution decomposes, and calomel is deposited if exposed to the light. Ether and alcohol both dissolve it freely. It is an exceedingly powerful and acrid poison. Its antidote is white of egg, with which it forms an insoluble compound. With oxygen it forms three oxychlorides. It is used in dyeing and calico-printing, and in photography; also in medicine in certain skin diseases.

MERCURY, FULMINATING. (*See* FULMINATING MERCURY.)

MERCURY, IODIDES OF, in Chem.—Mercury forms three iodides,—the green, or subiodide, Hg_2I, formed by triturating 127 parts of iodine with 200 of mercury; the protiodide, HgI, made by precipitating a solution of corrosive sublimate with iodide of potassium, and an unimportant intermediate iodide. The protiodide (or biniodide as it was formerly called) illustrates, very curiously, the difference of colour resulting from difference of form. The precipitate, when first formed, is salmon-colour, but gradually passes into a brilliant scarlet. It fuses at 400°, and sublimes in yellow rhombic tables. By simply rubbing the yellow salt, or even by touching it with a point, it immediately becomes transformed into brilliant red octahedra with a square base.

MERCURY, NITRATES OF, in Chem.—Mercury forms several nitrates. It will be only necessary to mention two. The subnitrate, $Hg_2O\,NO_5$, is prepared by acting on exc[illegible] in the cold. It forms fine colourless crystals with two equivalents of water. If dissolved in water, it decomposes into the basic nitrate. The nitrate of mercury, $HgO\,NO_5$, is prepared by dissolving mercury in excess of nitric acid by the aid of heat. It may be obtained in crystals by exposing the solution in nitric acid to a freezing mixture; but if solution in water be attempted, a basic nitrate is formed.

MERCURY, OXIDES OF, in Chem.—Mercury forms two oxides,—the black, or suboxide, Hg_2O, and the red, or oxide, HgO, both of which form salts with acids. The suboxide, though a strong base when in combination, is very unstable when isolated. It is obtained by sublimating finely levigated calomel with solution of potash or soda, and washing the black precipitate with cold water. It is decomposed by a strong light, or a gentle heat, into the red oxide and the metal. The red oxide may be made by exposing metallic [mercu]ry to a current of air at 700°, or more readily by decomposing the nitrate by heat. It is thrown down as a yellow powder when potash or soda is added to a solution of corrosive sublimate. The precipitated oxide does not differ from the red form, but appears to be a merely molecular variation. This oxide, when heated, becomes converted into the metal and oxygen gas, and was used both analytically and synthetically by Lavoisier, in the determination of the composition of atmospheric air.

MERCURY, SULPHATES OF.—There are several sulphates of mercury, the most important of which is that formed by decomposing with water the sulphate of [illegible] to a tribasic insoluble yellow sulphate, known as *turbith mineral*.

MERCURY, SULPHIDES OF, in Chem.—There are two sulphides of mercury,—the subsulphide, Hg_2S, and the sulphide, HgS. The first is formed as a black precipitate when a solution of an alkaline sulphide is gradually added to a solution of a subsalt of mercury. The sulphide exists as cinnabar in the mineral kingdom. It is [illegible] as vermilion, by rubbing together 300 part[s] [illegible] and 114 parts of sulphur in a mortar for two or three hours. The black sulphide obtained is thrown into a solution of 75 parts of hydrate of potash to 400 of water, and kept at a temperature of 122° Fahr., until the whole has assumed a fine red colour. The sulphide exists also in a black form, obtained by precipitating a salt of mercury with sulphuretted hydrogen. It is transformed by sublimation into the red variety.

MERIDIAN, *me-rid'-e-an* (from the Lat. *meridies*, the mid-day), is, in Astron., the great circle of the sphere which passes through the earth's surface and the zenith of the spectator. It is consequently the circle on which the latitudes of places are reckoned, commencing from the equator, which it intersects at right angles. What is termed the *terrestrial meridian* is the [gr]eat c[ir]cle formed by the intersection of the surface [of the ear]th by the plane passing through the poles and the spot on which the spectator may be standing. The *first meridian* is the meridian from which longitudes are reckoned: it differs accordingly, as its posi-

from Paris; that of England from Greenwich, &c. (*See* LATITUDE AND LONGITUDE.) The *meridian* of a globe is a brass ring in which it is inclosed, and capable o' being moved round in any direction. This meridian is graduated with meridian lines, traced generally 15° from each other; so that the difference of longitude corresponds to any hour of time.

MERMAID, *mer'-maid* (from Ang.-Sax. *mere*, the sea, and *maid*), a fabulous creature, described by seamen as possessing a figure, the upper part of which is like a woman, while the extremities are those of a fish. Mermaids are usually represented with long hair, which they are believed to be constantly combing. The supposition, no doubt, owes its origin to the appearance of some of the cetaceans, as the phocæ, which at a distance resemble the description given of the mermaid.

MERULIUS, *mer-u'-le-us*, in Bot., a gen. of *Fungi*. The species *M. lacrymans* and *vastator* are two of the fungi which occur in the *dry rot* of timber.

MESEMBRYACEÆ, or FICOIDEÆ, *me-sem-bri-a'-se-e* (Gr. *mesembria*, mid-day; *anthemon*, flower), in Bot., the Ice-plant or Fig-marigold fam., a nat. ord. of *Dicotyledones*, sub-class *Calyciflora*, having the following essential characters:—Succulent herbs or shrubs, with simple exstipulate leaves; sepals definite, generally more or less united to the ovary; petals very numerous, or absent; stamens perigynous, ovary inferior or nearly superior; styles distinct; placentas axile, free, central, or parietal. Fruit capsular or indehiscent. Seed with a curved or spiral embryo on the outside of mealy albumen. The plants of this order are natives exclusively of warm and tropical regions. There are 16 genera and 440 species. Several are edible, others yield large quantities of soda when burnt. (*See* next article.)

MESEMBRYANTHEMUM, *me-sem-bri-an'-the-mum* (Gr. *mesembria*, mid-day; *anthemon*, flower), in Bot., the typical gen. of the nat. ord. *Mesembryaceæ*. The species *M. crystallinum* is the *ice-plant*, so called from its surface being studded with little watery vesicles of an ice-like appearance. Its ashes contain a large proportion of soda. The leaves and fruits of some species are eaten by the natives of South Africa.

MESMERISM, *mez'-mer-ism*, a term generally applied to the phenomena of animal magnetism, and so called after the name of Mesmer, its first propounder, who lived in the latter part of the 18th century. Up to the present day, the phenomena of mesmerism have not been satisfactorily accounted for; but originally it was supposed that an analogy really existed between the action of the mineral magnet and human energy. Animal magnetism—an incorrect but convenient phrase—may be described as a power which a stronger is supposed to be able to exert over a weaker person, or a healthy over a diseased; whereby, through a mere exertion of the will in some cases, but more generally by this means accompanied by stroking with the hands, the former throws the latter into a state of sleep. During this state, certain peculiar sensations are experienced, which arise from nervous excitement, and may have good effects upon the health of the patient. The method by which mesmerism is generally performed is as follows:—The patient is placed in a sitting posture, in a convenient elbow-chair or couch. The mesmeriser, seated on a chair a little more elevated, and at the distance of about a foot from the patient, collects himself for some moments, during which he takes the thumbs of the patient between his two fingers, so that the interior parts of the thumbs are in contact with one another. He fixes his eyes upon the eyes of the patient, and remains in this position till he feels that an equal degree of heat is established between the thumbs of both parties. Withdrawing his hands, he then places them on the shoulder, where he allows them to remain for about a minute, and then conducts them slowly, with a very slight friction, along the arms to the extremity of the fingers. This operation is called a *pass*, and is repeated five or six times. *Passes* are then made over the rest of the body, ending finally with several transverse *passes* before the face and breast, at the distance of from three to four inches, the hands being approximated to each other and then separated abruptly. There are many variations of the mesmeric process, but the result, when there is no obstacle or deranging cause, is that the patient falls involuntarily into a kind of trance, the progressive sensations of which have been thus classified by Kluge, a German philosopher.—The *first* degree, called *waking*, presents no remarkable phenomena. The intellect and the senses still retain their usual powers and susceptibilities. In the *second* degree, called *half-sleep*, or the *imperfect crisis*, most of the senses still remain in a state of activity, that of vision only being impaired, the eye withdrawing itself gradually from the power of the will. In the *third* degree, called the *magnetic* or *mesmeric sleep*, the senses refuse to perform their respective functions and the patient is unconscious. In the *fourth* degree, called *simple somnambulism*, or the *perfect crisis*, the patient is said to "wake, as it were within himself, and his consciousness returns." He is in a state which cannot be called sleeping or waking, but which appears to be something between the two. In the *fifth* degree, called *lucidity*, or *lucid vision*, the patient is placed in what is called the state of *self-intuition*. In France, and in this country generally, this state is called *clairvoyance*; in Germany, *Hellsehen*. When in this state, he is said to have a clear knowledge of his own internal mental and bodily state, is enabled to calculate with accuracy the phenomena of disease which will naturally and inevitably occur, and to determine what are their most appropriate and effectual remedies. In the *sixth* degree, called *universal lucidity*, the *lucid vision*, possessed in the former degree, extends to all objects, near and at a distance, in space and time. Many persons, however, who practise mesmerism, are sceptical with regard to the existence of the two last degrees, although such cases are recorded by the best authorities on the subject. The dispassionate investigation of mesmerism has been shunned by men of science, on account of the imposture of some and the credulity of others of its professors. M. Reichenbach, a distinguished German chemist, gave a more scientific aspect to the phenomena of animal magnetism, by stating that he had discovered a new force in nature, called the Od force, or Odyle. He regarded this as a peculiar force in nature, the presence of which could only be detected by persons of a highly susceptible nature. As, however, his conclusions were arrived at principally through the medium of others, and those in a morbid state, his theory has been generally rejected. Electro-biology is only another form which the public exhibition of animal-magnetism has assumed. Sleep is produced by making persons gaze for a certain length of time on a piece of money which is placed in the hand. In susceptible individuals, this produces a kind of cataleptic sleep, in which they exhibit all the phenomena of the mesmeric state.—Ref. *An Inquiry into the Origin, Progress, and Present State of Animal Magnetism*, by J. C. Colquhoun; *Foreign Review*, vol. v.; and Braid's *Neurypnology*; *or, the Rationale of the Nervous Sleep*.

MESS, *mess* (from Fr. *mets*, a dish of meats), in nautical language, denotes any particular company or class of the crew of a ship who mess together, or, in other words, partake of their meals in company; as the *gun-room mess*, &c. In the army, the word *mess* is capable of a more extended signification, as it applies to the whole of the officers of a regiment, who in a species of club mess together. The mess is kept up by a certain proportion contributed from each officer's pay. The funds thus collected are termed the *mess funds*, out of which all expenses connected with the victualling department of the officers are defrayed. A bottle of wine is supplied to each officer every day at mess gratis, on the part of the commander-in-chief; it is termed the "Regent's allowance," on account of its being instituted by George IV. when regent.

MESSENGER-AT-ARMS, *mes'-sen-jer*, in Scotland, is an officer employed to execute the writs issued from the superior courts. Each messenger is obliged to find security for the proper performance of his official duties, which require to be executed with great precision, as they are not only amenable to questions regarding the liberty of the subject, but upon the legal accuracy of some of their acts the title to landed property may afterwards depend.

MESSENGER, KING'S or **QUEEN'S**, certain officers employed under the secretaries of state, who are kept in readiness to carry despatches either at home

or abroad. They were formerly employed for serving the secretaries' warrants for the apprehension of persons accused of high treason; and in such cases it was not at all uncommon for them to detain their prisoners at their own houses. As a remarkable instance of this practice, we may mention that in the year 1713, the ambassador of Morocco was taken into custody by a king's messenger, on January 9, and was not released until July 11, a space of six months.

Mespilus, *mes'-pi-lus* (Gr. *mespilon*), in Bot., a gen. of the nat. ord. *Rosaceæ*. *M. germanica* is one of our orchard trees, yielding the peculiar fruit called the medlar.

Messiah, *mes-si'-ah*, a Hebrew word, signifying "the Anointed," and applied, as expressive of eminence, to our Saviour. In the Greek translation from the original, the word is read *Christos;* whence our Christ. It was the custom of the Jewish nation to anoint all high personages, as kings, &c.; and thus the title was applied to Jesus on account of his high position, as next to God himself. The Jews, however, deny that the Messiah has yet come, and they are looking out for and expecting his arrival, in order that their [illegible] nation may be restored to [illegible]

Mesua, *me-su'-a*, in Bot., a gen. of the nat. ord. *Guttiferæ*. The species constituting it are remarkable for their very hard timber. The flower-buds of *M. ferrea* occur in the bazaars of India under the name of *Nag-kesur*. they are highly esteemed for their fragrance, which somewhat resembles that of violets. In Bengal, these flower-buds, as well as the leaves of the same plant, are employed as antidotes to snake-poisons. It is named in honour of two celebrated Arabian physicians and botanists, father and son, who resided at Damascus, and flourished in the 8th and 9th centuries.

Metallurgy, *me-tăl'-lur-je* (Gr. *metallon*, metal; *ergon*, work).—Percy defines metallurgy as "the art of extracting metals from their ores, and adapting them to various processes of manufacture." The [illegible] first extracts the ores from the earth, and by mechanical processes of dressing frees them from foreign matter more or less completely, so as to render them fit for treatment by the metallurgist. The best way of [illegible] of metallurgy is by practical [illegible] processes of smelting as carried on in different localities both at home and abroad. An excellent acquaintance with the subject may, however, be gained by the study of such books as Percy's "Metallurgy," Karsten's "System of Metallurgy," and Le Play's "Traité de Métallurgie," accompanied by a close examination of the typical ores, the illustrations of the various processes of smelting, and the sections and drawings of furnaces, —of which there is a most complete collection at the Museum of the School of Mines, Jermyn Street. Metallurgical processes are divided into *dry* and *wet:* the ordinary process for smelting copper, and the method of reducing the same metal from its solution in hydrochloric acid by means of iron, may be taken as examples of these t[illegible]. The methods of reducing the vario[illegible] will be found described under their respective heads.

Metals, *met'-ălz* (Lat. *metallum*, a metal).—Metals may be divided into class[illegible] to two systems, the one having for its [illegible] physical, the other the chemical properties of those bodies. Percy (*Metallurgy*, vol. i.) classifies them according to their fusibility, including however only the [illegible] in his classification. *a. Fusible below* [illegible],—[illegible], lead, &c. *b. Fusible above redness, but at temperatures easily attainable in furnaces*,—copper, gold, &c. *c. Fusible only at the highest heat attainable in furnaces*, —nickel, manganese, &c. *d. Practically infusible in ordinary furnaces*,—platinum, iridium, &c. He also divides them into—*a. Fixed metals*,—gold, copper, nickel, &c. *b. Volatile metals: after fusion*, cadmium, zinc, &c.; *without fusion, passing directly from the solid to the gaseous state*,—arsenic. The specific gravity of metals at ordinary temperatures has an exceedingly wide range, from lithium ·598, which is lighter than any known fluid, to osmium, which is as high as 21·5. All metals bear a definite form of crystallization, which is produced principally in three ways,—by slow solidification after fusion, by condensation from vapour, and by electrotypic decomposition. Metals differ considerably in their structure, not only with regard to each other but in relation to themselves. Some are crystalline, as zinc, antimony, and bismuth; others are granular, like pig-iron; others fibrous, like bar iron and copper; while some few are columnar, like grain-tin; and conchoidal, as in some brittle alloys,—speculum metals for instance. Two of the principal physical characteristics of metals are, ductility, the property of being permanently extended by traction, as in wire-drawing, and malleability, which is the property of extending in all directions under the hammer. The following tables show that these properties are distinct:—

Malleability.	*Ductility.*
Gold.	Gold.
Silver.	Silver.
Copper.	Platinum.
Tin	Iron.
Platinum.	Nickel.
Lead.	Copper.
Zinc.	Zinc.
Iron.	Tin.
Nickel.	Lead.

The power of metals for conducting electricity is shown in the following table from Matthiessen (*Phil. Trans.* 1863):—

Silver	100·	at 32° Fahr.
Copper	99·95	
Gold	77·96	
Zinc	29·02	
Iron	16·81	
Tin	12·36	
Lead	8·32	
Antimony .	4·62	
Bismuth ...	1·24	

Their power of conducting heat is exhibited in the following table by Weidemann and Franz:—

Silv	100·	at 12° C.
Copper	73·6	
Gold ..	53·2	
Tin	14·5	
Iron	11·9	
Lead ...	8·5	
Bismuth	1·8	

The order of conductivity for heat and electricity is nearly the same. So much for the physical properties of metals. Chemically speaking, they may be divided into seven principal groups:—I. The metals of the alkalies,—potassium, sodium, lithium, rubidium, cæsium. They all have an intense affinity for oxygen, and decompose water at ordinary temperatures. They form two or more oxides, both soluble in water. Thallium is supposed by Lamy to belong to this group; but the experiments of Crookes, its discoverer, prove conclusively that it is a heavy metal belonging to the lead group.—II. The metals of the alkaline earths,—[illegible], strontium, calcium, magnesium. These metals, [illegible] of magnesium, which seems closely allied to zinc in many of its properties, decompose water at all temperatures, and form one oxide pretty soluble in water.—III. Metals of the earths,—aluminium, glucinum, cerium, and seven others of great rarity. [illegible] are insoluble in water, and they do not decompose water at ordinary temperatures.—IV. Metals analogous to tin,—zinc, cadmium, cobalt, nickel, uranium, iron, chromium, manganese. These metals, [illegible] dull redness, decompose the vapour of water when transmitted over them, becoming converted into oxides while hydrogen escapes. Three of them, iron, chromium, and manganese, form powerful acids.—V. Metals forming powerful acids with oxygen,—tin, titanium, molybdenum, tungsten, vanadium, arsenic, antimony, tellurium, and one or two more.—VI. The next group contains bismuth, copper, lead, and thallium, metals which exert no decomposing action on water even at a full red heat. They form strong basic oxides, and exhibit a strong tendency to form subsalts. The last group contains the noble metals, mercury, silver, gold, platinum, and the heavy metals associated with it. These metals do not decompose water at any temperature, and have so feeble an affinity for oxygen, that their oxides, with the exception of osmium (which is

allied to arsenic in some of its properties), are reduced far below a red heat. Tellurium, arsenic, and antimony form connecting links between the metallic and non-metallic elements, being allied to the phosphorus and sulphur group in many of their chemical properties. As our knowledge of these valuable and interesting bodies extends, uses are found for many raw metals, their rarity decreasing with the demand. Sodium, lithium, aluminium, magnesium, tungsten, cerium, uranium, are instances of this; and no doubt as the sciences of metallurgy and chemistry progress, many other metals, at present only seen in the laboratory, will become common in the workshop.

Metamerides, *me-tăm'-e-ridez* (Gr. *meta*, together; *meros*, a part), contain the same centesimal composition, but differ so completely in their physical and chemical characters as to be considered distinct; thus, acetate of methyl and formic ether, fruit, sugar, and hydrated lactic and acetic acid, have respectively the same composition in 100 parts, but are essentially different in their properties. The formulæ adopted for the first two of these will illustrate this —

Acetate of Methyl.

$$C_2H_3O,C_4H_3O_3=(C_6H_6O_4)\text{, and}$$

Formic ether.

$$C_4H_5O,C_2HO_3=(C_6H_6O_4)$$

It will be seen from this that the ultimate atoms of C, H and O are grouped together in two different ways.

Metamorphosis, *met'-ă-mor'-fo-sis* (Gr. [illegible]; *morphe*, form), transformation; [illegible] or thing into another form. [illegible] kinds of metamorphosis,—the one real, the other apparent. The metamorphosis of Jupiter into a bull, and of Minerva into an old woman, were only apparent, whilst the transformations of Lycaon into a wolf, and of Arachne into a spider, were held to be real metamorphoses. The idea of metamorphosis presents a great charm to the active imagination of nations in the first stages of their history; and early man, unable, from his limited knowledge, to refer [illegible] nature to their proper causes, allows [illegible] to ascribe these mysteries to metamorph[illegible] the ancient metamorphoses include some allegorical meaning. Ovid's collection of narratives respecting the change wrought by the power of the gods of Greece and Rome is a history of transformations poetically related. In Natural History, the word *metamorphosis* is occasionally applied to any change in the organization of matter; as for instance, the transformation of food or rain into animal or vegetable organic substances; but the term is more strictly applied to those sudden changes in the form of things which are so obvious and interesting to even the unscientific observer; as the change of the pupa into a butterfly, to quote an instance from the insect world. (*See* Insect-Transformations.)

Metaphor, *met'-ă-for* (Gr. *meta*, over, and [illegible], I carry), a figure in Rhet., expressing a [illegible] similitude, that is to say, one that is exemplified in a single word. The metaphor is transferred, as its name implies, from the subject to which it properly bel[ongs] to another to which it is added in order to co[nvey] a peculiar sense. It must be merely an epithet or an auxiliary term; whence arises its difference from Comparison (which *see*). Thus, to say "that man is a serpent" is a metaphor; whereas "that man is like a serpent" would be a comparison, or similitude. In respect to this latter quality, the metaphor may either put something animate or intellectual for something inanimate and material; for example, one may say, "the wrath of the sea," "[illegible]," so as to represent water as endowed with will. As those impressions which we receive through the senses are the liveliest, so the designation of things spiritual by images taken from the material world may often produce a striking effect. Brevity and power are the characteristics of the metaphor; while novelty shows the original wit; unexpected contrast may thus produce an effect sublime and ridiculous in the highest degree.

Metaphysics, *met'-a-fiz-iks* (Gr. *ta meta ta phusika*), —a word probably manufactured by Andronicus Rhodius, the first editor of Aristotle,—when taken in its widest signification, is a term applied to the philosophy of mind in general. Considered in its more special senses, it is synonymous with (1) psychology, or that branch of science that deals particularly with the manifestations or phenomena of mind; and (2) with ontology, as it is called, or with the rational inferences to be derived from those phenomena. Thus, the term is properly applied to two sets of mental manifestations,—to phenomenal psychology on the one hand, and to inferential psychology on the other. In the former department, the phenomena or facts of consciousness may be studied in themselves simply as such and such mental appearances, or they may be studied in their necessary and universal manifestations as such and such laws of mind. In the latter, again, or the science of being, as it has been called, the facts of consciousness, as such, simply form the ground-work of legitimate conclusions respecting the existence of something [illegible] own immediate phenomena. [illegible] mental modes and their laws, the other investigates, so far as this can be done, the existences of self, the world, and Deity. It must be distinctly understood, from first to last, that the science of being, properly so called, can make no pretensions to a deductive *à priori* knowledge of its objects. The human mind can and does logically know nothing of things in themselves; mind, or matter, or Deity, *per se*, can only be known, if known at all, by man, from the phenomena or manifestations which each respectively casts on the mirror of the human consciousness. It is simply by the effects revealed to [illegible] such objects that their existence can approx[imatel]y be concluded. If certain appearances come [illegible] in the soil of the mind, certain inferences are, and even must be, made from those appearances respecting the existences that are implied by them. In a word, no rational induction of the mental phenomena, legitimately considered and followed out, can help landing the investigator in the heart of conclusions, or at least surmises, respecting the existence of the soul, of the universe, and of God. So much for the science of being, or metaphysics proper. To take up now psychology proper. It was customary in this country, previous to the time of Kant, to resolve all the phenomena of the human mind either into Understanding and Will, or, which was hardly a preferable arrangement of them, to classify them into the Intellectual and Active powers. The former terminology was inherited by Locke from the Middle Ages, [illegible] to purity. Kant [illegible] of consciousn[ess] [illegible] Feeling and Desire, and Will. This threefold classification was considered so happy by philosophers, that every one of any distinction immediately adopted it as soon as it came to his knowledge. Consciousness, it must be remarked, is by no means one of those faculties. It is, properly, the mind itself in such or such a state or condition of activity or passivity. Consciousness [illegible] and to all of the above three- [illegible] If I know, I must be conscious of knowing; if I feel, I must be conscious of feeling; if I will, I must be conscious of willing. Thus, consciousness is the condition of all mental energy. A [philosophy] of consciousness is all but a philosophy of the mind, and mind and consciousness are often used synonymously. The following is Sir William Hamilton's distribution of consciousness or mind.—1. *Facts*, Phenomena, Empirical Psychology; and under these he would consider the Cognitions, Feelings and Conative Powers of Will and Desire. 2. *Laws*, Nomology, Rational Psychology; and under these he would consider the laws of our Cognitions (or Logic), the laws of our Feelings or Æsthetic (or the Beautiful, &c.), and the laws of our Conations or Moral Philosophy (or Ethics), and Political Philosophy. 3. *Results*—Ontology, Inferential Psychology; and under these he would consider the Being of God, and the Immortality of the Soul, &c. As these subjects have been, or are to be, taken up in this book, the only subject that now remains is the facts of consciousness themselves. Consciousness in itself, and in its spheres of application, has a double potency, a twofold region over which it rules. There is an internal and an external consciousness,—the one taking cognizance of all our mental states, properly so called, the other taking cognizance, through the senses, of the outer world, and

the peculiar forms of external perception. Sensation proper is the consciousness which we have of certain affections of our bodily organism, and usually ascribes to the outer world the source or cause of those affections. Perception proper, again, is the consciousness which we have of our bodily organism,—as extended, figured, and so forth; and in and through this consciousness, the immediate apprehension of an external material world. Thus, sensation is the consciousness which we have of the secondary qualities of matter, as they are called; namely, colour, taste, flavour, savour, and sound; and perception is the consciousness which we possess of the primary qualities of matter; viz., trinal extension, divisibility, size, density or rarity, shape, situation, and so forth. Sensation and perception co-exist in an inverse ratio, as Sir William Hamilton has shown, in each of the five senses. In the senses of smell and taste, for example, the sensational or subjective element is so obtrusive as to be universally regarded as quite special. Again, those of hearing, sight, and touch are nearly as universally, though not quite so correctly, regarded as objective or perceptional. In other terms, the senses of smell and taste are usually [illegible] vehicles of pleasure and pain, while [illegible] sight, and touch, are viewed as informing us respecting the material attributes of sound, colour, and resistance. Yet the latter quality—that of resistance—belongs more peculiarly and obtrusively to the locomotive faculty, as it has been called, or the power which the living body pos[illegible] al [illegible] another. It is this faculty which first informs us immediately of the existence of an extra-organic world. The external world, previous to the exercise of this power, is wholly intra-organic, but as soon as the will chooses to exert its energy, we are immediately conscious of something offering a resistance to it, and to the [illegible] at one and the same time. In addition to the five senses, there is sometimes recognized a muscular sense, or the peculiar consciousness we experience on the movement of a limb. Such are the feelings of lassitude, of fatigue, of ennui, of restlessness. This sense, it is obvious, can give us no information of anything save the special states of our own nervous organism. There is a seventh sense, the tactus venereus, as Julius Scaliger called it, which is obtrusively subjective. In addition to the primary and original powers possessed by the senses, there is a secondary or acquired power, which some of them obtain by the education of experience. Such are the knowledge of distance and of solidity, which every one of us at first sight ascribes to the sense of sight, and which is no less demonstrably certain to be derived originally from the sense of touch. It is only by a series of oft-repeated judgments respecting the colour and the comparative size of objects, that we learn to ascribe to each something like its proper distance and size, and this always at first in conjunction with the sense of touch.

It has been already observed that consciousness properly belongs to whatever occupies the regards of the mind, be it an external object or an internal one, a thought, a feeling, or a volition. Consciousness is in every mind occasionally clear or indistinct, according to the degree of attention which is given to the objects of consciousness. Are the objects of consciousness indistinct? This arises, *cæteris paribus*, from the degree of attention being obstructed and faint which is brought to bear on those objects. Are the objects of consciousness clear? This arises from the degree of attention given to them be[illegible] intense and free. It is impossible here to pursue [illegible] subject of indistinct or unconscious states of mind, but those who are curious will find much interesting speculation on an obscure subject in the "petites perceptions" of Leibnitz, and the "latent modifications" of Sir William Hamilton. Attention then may be defined as consciousness in pursuit of a definite object, or consciousness intensified. And it is to be observed that attention often exists to a high degree where volition has no place whatever. Such, for example, as when one is excited by some violent passion, it is notorious that the will, exert itself how it may, cannot withdraw the mind from fixing its most violent attention on the object of admiration or dislike, until the passion has in some degree cooled. Of course, where the will and the attention go together, or where the will and the desire point in the same direction, it is then that we may be said really to be conscious of the objects which occupy us. Attention, then, being necessary to every act of consciousness, and particularly to every clear and distinct act, those two powers taken together constitute the acquisitive power of the mind. But if the mind were destitute of any power of retaining its acquired perceptions, all knowledge, and even all consciousness, save of the most transitory kind, would be utterly impossible. So also would it be if the mind were destitute of any power of re[illegible] representing them when they were [illegible] to its bar. Thus we have, by the combination of retention and recollection, the faculty of *memory*, as ordinarily understood. And it may be observed, that it is very probable that no object which has once occupied the distinct consciousness of any mind can ever be entirely effaced. We cannot often recollect at the moment something that we are assured our memory has got stored away in some out of the way recess, and the chances are that we shall stumble over this very thing that we are in search of, it may be days, months, or years after. It is the recollective power that we all are more or less deficient in much more than the retentive. Again if I try, through my memory, to recall some event or scene in which I am interested, the mind must have some *where* or place to put that which is summoned before [illegible]'s consciousness. It must either hold it in the grasp [illegible]f the pure intellect, or, if being picturable, it must be handed over to the *imagination*. If the former, it belongs properly to the intuitive and symbolical knowledge of logic; if the latter, it is properly the work of the fancy. Dr. Mansel, of Oxford, combines both powers under the general head of representative consciousness, without apparently discriminating very sharply in this relation the conceptive power of the mind from the power of forming pictures. (For conception, judgment, and reasoning, *see* LOGIC.) As closely connected with the phenomena of memory and imagination, we have the laws of *mental suggestion* or association, not only as lying very near the foundation of those faculties, but ruling in a large measure the entire territories of the mind; for suggestion holds sway over all its phenomena, except those that come under the category of necessary truths. A syllogism affords a convenient example in logic, and the relations of parent and child, of greater and less, and of cause and effect, are instances in metaphysics. There [illegible], probably, no subject that has called forth more of [illegible] attention of the highest minds in speculative philosophy than this very one of suggestion. Without going into the history of the subject, it can only be observed that probably the subject has been treated best by Aristotle, Hobbes, Hume, and Sir Wm. Hamilton. The views of the latter respecting the phenomena of association are that they resolve themselves into the special laws of—1. repetition; 2. indirect remembrance, and 3. preference. This appears [illegible] be the most complete analysis which those laws have yet received. 1. The law of repetition runs thus: Thoughts co-identical in mode, but differing in time, tend to suggest each other. 2. The law of indirect remembrance is that thoughts once co-identical in time, are—differ as they may among themselves—again suggestive of each other, and that in the mutual order which they originally held. 3. The law of preference is this, that thoughts are suggested, not merely by a [illegible] relation between each other, but in proportion [illegible] these thoughts have to the individual mind. (*See* ASSOCIATION.) (For an analysis of the passions, emotions, desires, the moral faculty, and the will, the reader is referred to the article ETHICS.) There are certain facts of consciousness of a necessary character, that though at first mainly derived through experience, yet, when once acquired, possess an irresistible truth. These are what are called *à priori* truths in the Kantian and modern philosophy, as contrasted with those other branches of knowledge which we derive wholly through experience, and which receive the name of *à posteriori*. Such are, to take the easiest instances, the truths of arithmetic, geometry, logic, and so forth. No conceivable power can make us, as

we are at present constituted—and this is all that psychology troubles itself about—think of two and two as being anything else than four, or that two straight lines, by any possibility, can inclose a space, or that the same individual can be both tall and short at the same time, judged by a single standard of height. It is quite the reverse with such a truth as that day and night succeed each other every twenty-four hours, for we have only to go to Lapland to find that truth no longer holding. The former are necessary or *à priori* truths, the latter is a contingent or *à posteriori* one. Now, the laws of association, which have just been considered, while they can readily afford explanations of the contingent facts of consciousness, can g[ive] no clue at all to an explanation of those necessary o[nes]. One is not a whit surer that two and two make four, after the hundredth experiment, than he was after the first; which is not the case where suggestion holds sway. So I know any better after having examined a thousand objects, that the qualities of each and all of them express to consciousness as many distinct substances, than I did after examining the first object? Do I know any better after observing a thousand changes, that each and all of them imply a cause, than I did after witnessing the first change with intelligence? Can my knowledge of th[e] t[ruth] that ingratitude is at all times worthy of condemnation be said to be proved by my years? Are not each and all of those truths incontestable once and for ever? Those judgments which seem to possess this quality of necessity, which no theory of the laws of suggestion can explain, are reducible to three heads:—1. Logical judgments, springing from the laws of identity, contradiction, and excluded middle, are wholly of this class. Such are the truths of arithmetic and geometry; as, the sums of equals are themselves equal, and two straight lines cannot inclose a space. Dr. Mansel, in his "Metaphysics," ranks the latter judgment under the head of mathematical judgments, as distinguished from logical ones; but there appears to be no necessity for this, as the judgment is wholly explicable on the logical principle of contradiction. Mathematical judgments are only logical ones applied to continuous or discrete quantity.—2. Metaphysical judgments expressing an apparently necessary relation between what is known and what is unknown; as that every quality implies a substance in which it inheres, and that every change implies some cause. Such are the laws, when carried into their highest development, on which hang entirely our beliefs of the permanent existence an[d] [illegible] of the human self, of the permanence and [illegible] of the outer world and of the perpetual existence of a Maker of both the outer world and the inner.—3. Moral judgments, or such as state the immutable obligation of certain courses of conduct,—as, Be just, be kind, be courageous, be honest, be grateful,—are, so far as we can see—and that is all that psychology has to do with—altogether incontestable. There is no man in his senses who would impose on his fellow the general obligation "be unjust," however many men our law courts may find to transgress the general obligation in special instances.

If the mind possesses necessary and universal truths, a question of some interest here arises, Can we hereby transcend the experience of [illegible], I transcend, indeed, the bounds of all p[ossi]ble experience? Necessity not being a result of experience, arising, indeed, from the application of certain native principles of the mind to the facts or phenomena of consciousness, at first sight would seem to warrant the belief that by those very principles of universality and necessity which have just been evolved, it is possible for thought to contemplate in their realities those truths which transcend experience. Let us reflect. We have never seen a perfect geometrical surface, or that *pons asinorum* of schoolboys, a perfect point or line. Yet how readily we can abstract from the wood or paper, on which such objects are usually presented to us, the material element which clogs the apprehension, and seize upon the pure point, line, surface which lurk behind. Now, no one requires to be told that for the exercise of such abstraction, the necessary conception of pure space is essential. What does this show us? It shows that there must always be a basis for the necessary truth to work upon, and that it is wholly a [illegible]tal element which is gained by the application of [illegible] truths. We have experience of nothing but fini[te] and relative objects, as we had experience just now only of material surfaces. Have we any faculty or faculties which will enable [illegible] transcend those limited objects and enable us to contemplate infinitude and absolute existence? If we weigh those necessary truths one by one, we shall find no warrant for maintaining that logic can give us such powers, and the question is, can metaphysics or ethics do so? But when we put logic out of court, we put *comprehension*, clear and distinct, out of court [al]ong with it. What then remains? Nothing but *belief*. Logic deals wholly with the comprehensible; [o]ntology deals wholly with belief. We cannot comprehend things in themselves, yet we all *believe* in them. Experience rules logic; ontology rules the highest beliefs we possess.—*Ref.* Hamilton's *Lectures on Metaphysics*; Dr. Mansel's *Metaphysics*, or the article in the *Encyclopædia Britannica* under this head; Hamilton's edition of Reid's *Works*; Dugald Stewart's *Works*; Kant's *Kritik der reinen Vernunft*; Cousin's *Lectures on the History of Speculative Philosophy*, &c.

METASTASIS, *me-tăs'-tă-sis* (Gr. *methistemi*, I transfer), in Med., is the sudden transference of a diseased action from one part of the body to another; as when a cutaneous eruption is suddenly checked by exposure to cold, and the disease attacks a deep-seated part; or, in gout, where the disease suddenly shifts from the foot to the stomach, or some other internal part.

METEMPSYCHOSIS, *me-tem-se-ko'-sis* (Gr. *meta*, beyond, and *empsucho*, I animate), is the supposed transmigratio[n] o[f sou]ls from one body to another. This idea belongs to the oldest religions of India and Egypt. Pythagoras, who is said to have borrowed his notion from the Egyptians, held that after death men's souls passed into other bodies, of this or that kind, according to the life they had led. This is also a prominent feature in the systems of Brahminism and Buddhism, which represent the soul as passing after death into the body of a higher or lower animal, as a reward of virtue or a penalty for vice. Human life is regarded only as a link in a chain of conditions through which the soul passes in a long career of procession from God and return to him. A period of 12,000 divine years, each [illegible] human years, is assigned as the period [illegible] and purification, after [wh]ich the soul receives its reward of being absorbed in the divine nature. Plato maintained the pre-existence of the soul before its appearance in man, and that of this prior state it retained some dim reminiscences. After death, according to its peculiar qualities, it seeks a new body suitable to it. Every soul, according to him, returns to its original source in 10,000 years. The idea of metempsychosis subsequently appears in the speculations of the Neo-Platonists, in the Cabala of the Jews, and even in the writings of Origen. In recent times, the system was revived by Fourier.

METEMPTOSIS, *me-temp-to'-sis* (Gr. *meta*, after, and *pipto*, I fall), in Chron., is a term used to express the solar equation necessary to prevent the new moon from happening a day too late; as *proëmptosis* signifies the lunar equation necessary to prevent the new moon happening too soon.

METEORIC STONES. (*See* AEROLITE.)

METEOROLOGY, *me-te-or-ŏl'-o-je* (Gr. *meteoros*, raised in the air; *logos*, a discourse), the science which treats of the phenomena which occur in the atmosphere and leads us to inquire into their properties and relations. In all conditions and stations in life, men are led, by motives of necessity or comfort, to study the appearance of the atmosphere and sky, in order to arrive at some indications of the weather. Every varying appearance which may betoken some change is carefully stored up in the minds of sailors, fishermen, husbandmen, shepherds, and hunters. These results form a vague body of rules, in which facts are often stated correctly, but, through credulity, ignorance, and superstition, they are so frequently mixed up with erroneous deductions, that they form an unsafe basis for the science. From these causes arises the disposition to refer the ordinary changes of the weather to the influence of the moon or stars, and also to look upon comets and meteors as the forerunners of catastrophes, either in the moral or physical world. The history of

meteorology is difficult to trace, since little information is cast upon it by the records of antiquity. The observations of the ancients were chiefly directed to changes in the weather; and by personal assiduity they were enabled to prognosticate often with considerable certainty. The philosophers of old were willing to explain the phenomena by the most vague hypotheses, referring them to stellar and planetary influences. There were also to be found, in those times, persons who were believed to possess supernatural influence over atmospheric changes. The priests of Samothrace promised auspicious winds to such as consulted their sacred oracle; and Empedocles, of Sicily, boasted in his song of a knowledge of the mystic art. At the fountain Hagno, in Arcadia, in the time of drought, the priests of Jupiter were accustomed to offer up sacrifices—touching the water with an oaken wand—when presently a vapour rose, and shortly afterwards a pleasant rain descended. Such miraculous powers were believed to be given to mortals even in more recent times; in the reign of Constantine, Sopater of Apamea was put to death because he was supposed to have stilled the winds and thereby caused the plague which then raged at Constantinople. As the study of natural science progressed, the casual precursors of phenomena were separated from the real causes, false conclusions were refuted, and the empty terrors to which they gave rise were dissipated. By widely-extended observations in all the realms of natural science, at length were gained the general rules by which the phenomena of the atmosphere are regulated. From chemistry, meteorology borrows her analysis to determine the [illegible] the air itself, of the substances which it contains and by which it is acted upon; the manner in which the different processes of evaporation, freezing, thawing, &c., go on, and how they affect the state of the atmosphere; the action of those invisible and imponderable agents, light, heat, electricity, &c., and [illegible] dous results. From physics, meteorology [illegible] mechanical action of these and [illegible] powers and substances, the weight and velocity of the air, the laws of the reflection, refraction, and motion of light, &c. By these aids, the science of meteorology explains the formation, fall, or deposition of [illegible], rain, dew, and frost; the action of thunder and lightning, the prevalence of certain winds and their particular properties; the effect of the position of a country and the nature of its surface on its climate and productions; and the nature and cause of meteors. In order to arrive at correct results with respect to several of these branches of meteorology, several useful instruments have been invented, which will be found described under the articles BAROMETER, HYGROMETER, and THERMOMETER. The reader will also find branches of this interesting and important subject treated of under the articles AIR, ATMOSPHERE, CLOUD, EVAPORATION, FREEZING, HEAT, LIGHT, ELECTRICITY, PHYSICAL GEOGRAPHY, SNOW, &c.—*Ref.* Saussure's *Essais sur l'Hygométrie*, De Luc's *Idées sur la Météorologie*; and Daniell's *Meteorological Essays and Observations*.

METEORS, *me'-te-ors* (Gr. *meteora*).—In a general sense, this term is applied to any of the various physical phenomena which have their origin in the atmosphere. (*See* METEOROLOGY.) In a more restricted sense, however, the word denotes those fiery and luminous bodies which appear suddenly and at uncertain times either in the atmosphere or in higher regions. Amongst these may be mentioned the *bolis*, or fire-ball, a luminous meteor of great splendour, moving with considerable velocity at various altitudes, and frequently of great magnitude. The meteor is generally accompanied by a tail, and disappears in scintillations, attended sometimes by an explosion, occasionally leaving a luminous track behind, after it has become invisible. Fire-balls occasionally accompany meteoric stones in their descent; nevertheless, these phenomena must be considered independent, for the bolis may appear without the meteorolite, and *vice versâ*. Many extraordinary meteors have been seen and recorded: one of the most remarkable is that described by Blagden in the "Philosophical Transactions." It occurred on the 18th August, 1783, about 9 p.m., and was visible over a wide extent of Europe, from the north of Ireland to Rome, frequently changing its form and colour. It crossed the zenith at Edinburgh, and then appeared round and of a greenish colour, casting a shade upon the ground of a similar tint; a tail of considerable length attended it. At Greenwich it appeared like two bright balls, followed by a number of others, connected together by a luminous body, and finally terminating in a blaze, tapering to a point; the colours of the balls were different. The height of this meteor was estimated to be far above the surface of our atmosphere, its speed was not less than 1,000 yards per minute, and its diameter was computed at 2,800 yards. Cavallo describes this meteor as seen at Windsor, when its explosion was heard like a peal of thunder, ten minutes after its rupture was observed. On the 18th November, 1803, about 8.5 a.m., a brilliant meteor appeared in London, rendering legible the writings on the signboards. Many other meteors, of more or less brilliancy, have been observed at various times. (*See* AURORA BOREALIS.)

METHOD, *meth'-od* (Gr. *methodos*, a way), is the means or path by which we proceed to the attainment of some object or aim. In this sense, every art and science has its own proper method; but besides this, there is a universal method, or a science of method, by which every step in our progress through the whole circle of art and science should be directed. "The relations of things," says Coleridge, "form the prime objects, or, so to speak, the materials of method; and [illegible] those relations is the indispensable condition of thinking methodically." (*See* Coleridge on *Method*, introduction to *Encyclopædia Metropolitana*.) Descartes has also written a discourse on *Method*, in which he lays down four general rules to be [illegible] investigation. (*See* CARTESIAN [illegible] described as the fourth part of logic, and "may be called, in general, the art of disposing well a series of many thoughts, either for the [illegible] truth when we are ignorant of it, or for [illegible] to others when it is already known. Thus there are two kinds of method,—one for discovering truth, which is called analysis, or the method of resolution, and which may also be called the method of invention; and the other for explaining it to others when we have found it, which is called synthesis, or the method of composition, and which may be also called the method of doctrine."—*Port Royal Logic*. (*See* LOGIC.)

METHODISTS, *meth'-od-ists*.—Under this term are comprehended two principal and several subordinate sects, having totally distinct ecclesiastical organisations. The two grand sections also differ from each other upon points of doctrine, the one professing Arminian, the other Calvinistic sentiments. The former are the followers of John Wesley, and known as "Wesleyan Methodists," the latter the followers of George Whitfield, and commonly termed Calvinistic Methodists. The Wesleyan Methodists comprise the "Original Connexion," "New Connexion," "Primitive Methodists," "Bible Christians," "United Methodist Free Church," and "Wesleyan Reformers." The Calvinistic Methodists are the "Countess of Huntingdon's Connexion," and "Welsh Calvinistic Methodists." In 1729, John Wesley, when a fellow of Lincoln College, Oxford, with his brother Charles and a few others, began to hold small evening meetings for religious exercises. The name of Methodists was given to them on account of their regularity and strictness of conduct. The society was broken up by the departure of the Wesleys for Georgia, as chaplains for the colony which had been planted there. They returned to England in 1738. Hitherto they had held the opinions of extreme high churchmen; but a change having taken place in their views, they were debarred from officiating in the pulpit, and had recourse to preaching in private houses, fields, or waysides. The result of their preaching was a general awakening on the subject of religion throughout the land, and their followers became so numerous that it was necessary to form them into societies, and to draw up certain rules for their guidance. The only condition of membership was "a desire to flee from the wrath to come, and be saved from their sins." Members, however, after admission were expected (1) to abstain from doing harm, by avoiding evil of every sort, as quarrelling, fighting, drunkenness, swearing, profaning the Lord's day, un-

charitable or unprofitable conversation, the buying or selling of uncustomed goods, &c.; (2) to do good of every possible sort, and, as far as possible, to all men; (3) to attend upon all the ordinances of God. The peculiarities of the Wesleyan polity now developed themselves. In June, 1844, the first conference was held in London; the different parts of the kingdom were divided into circuits, and lay preachers were appointed. The doctrines held by the Wesleyans are substantially according with the Articles of the Established Church, interpreted in their Arminian sense. They maintain the doctrines of original depravity, an unlimited atonement, justification by faith, and a divine assurance of acceptance with God. Wesley distinctly declared himself an Arminian on the subject of predestination, understanding it in a sense not contrary to the doctrine of redemption, and the possible salvation of the whole human race. The public services of the Methodists present a combination of the forms of the Church of England with the usual practice of dissenting churches. In the larger chapels, the Church liturgy is used, and in all, the sacrament is administered according to the Church of England rubric. Love-feasts are occasionally celebrated, and on the last day of every year a solemn midnight meeting is held. One principal feature of Methodism is the system of classes, each being composed of about twelve persons, one of whom is appointed leader, whose duty it is to meet his class once a week, converse with each member, hear from him a statement of his spiritual condition, and give appropriate counsel. A society consists of one or more of these classes, and several of these societies form a circuit, which generally includes a town and the neighbouring villages. The public worship of these societies in each circuit is conducted by two descriptions of preachers,—the one clerical, the other lay. The former are set apart entirely for the work of the ministry, and are supported by funds raised for that purpose. From one to four of these "itinerant preachers" are appointed annually, for not exceeding three years in succession, to each circuit. Their ministry is not confined to any particular chapel, but they act interchangeably according to a plan generally re made every quarter, a preacher seldom officiating more than one Sunday in a chapel without a change. The lay, or "local" preachers, as they are called, follow secular callings, and preach on the Sundays at the places arranged for them on the above plan. Besides preaching in the various chapels in their respective circuits, the itinerant preachers administer the sacraments of baptism and the Lord's supper. One or other of them, according to arrangement, meets every class in his circuit once every quarter personally, converses with every member, and distributes to all who have walked orderly during the past three months a ticket of membership. One of the ministers in each circuit acts as superintendent. The highest Wesleyan court is the Conference, composed exclusively of ministers. It derives its authority from a deed of declaration, executed by Mr. Wesley in 1784, and which provided that after his death 100 persons, named in the deed, being preachers and expounders of God's Holy Word, should exercise the authority which Wesley himself possessed to appoint preachers to the various chapels. Vacancies are to be filled up by the remainder at the annual conference. Representatives selected by the district meetings, and such other ministers as are appointed or permitted to attend, are allowed to take part in the proceedings, and even to vote, though no decision is binding that has not the sanction of the legal hundred. The Conference must sit for at least five days, and not more than three weeks. It examines into the moral and ministerial character of every preacher, receives candidates on trial, and admits ministers into the connexion, and appoints preachers to particular circuits or stations. It also exercises a general superintendence over the various institutions of the body, including the appointment of various committees. In the "Original Connexion," to which the above remarks mainly apply, there were, according to the religious census of 1851, 428 circuits in Great Britain, with 1,024 ordained preachers, and between 13,000 and 14,000 lay preachers. In England and Wales, there were 6,579 chapels, with accommodation for 1,447,580. On 31st March, 1851, the attendance was—morning, 492,714; afternoon, 383,964; evening, 667,850. The "Methodist New Connexion" originated in a dispute that took place soon after Wesley's death, in 1791, regarding the admission of the laity to some participation in the government of the body. In the Original Connexion, all authority is virtually vested in the preachers; the New Connexion, on the contrary, admits the principle of lay participation in church government. The separation took place in 1797, and the New Connexion was formed under the leadership of the Rev. Alex. Kilham. In doctrine, and all the essential and distinctive features of Wesleyan Methodism, they are both alike; the Arminian tenets, and the outline of ecclesiastical machinery, comprising classes, circuits, districts, and conference, are the same in both. In 1851, they had 297 chapels and stations, with accommodation for 96,964 persons. The "Primitive Methodists," sometimes known as the Ranters, originated in Staffordshire, in 1810, in consequence of a desire among certain persons to revive the spirit and fervour of the early preachers. Their doctrines and ecclesiastical polity are similar to those of the Original Connexion, except in the admission of lay members to the Conference. The number of chapels and other places of worship in 1851 was 2,871, with accommodation for 369,216 persons. The "Bible Christians," or Bryanites, are not the result of any secession from the Methodist body, but grew up as an independent community, and adopted the essential principles of Methodism. Its founder was one William O'Bryan, a Wesleyan local preacher in Cornwall, who left that body in 1815, and began to form societies upon the Methodist plan. In doctrine, they do not differ from the other bodies of Arminian Methodists. In 1851, they had in England and Wales 482 chapels, &c., with 66,834 sittings. The "Wesleyan Methodist Association" originated in a dispute in 1834, regarding the establishment of a theological institution, and one minister who opposed it, and certain of his sympathizers, were expelled from the connexion, and formed a new body. The lay element has here more influence in matters of church discipline than with the Old Connexion, and the Annual Assembly (answering to the Conference) is composed of such itinerant and local preachers and others as the circuits, societies, or churches may elect, the number of representatives being regulated by the number of constituents—circuits with less than 500 members [illegible]; from 500 to 1,000, two; and above 1,000, [illegible]. In 1851, there were in England and Wales 419 chapels, &c., with 98,813 sittings. This body has lately become united with a number of the Wesleyan Reformers, under the name of the "United Methodist Free Church." The "Wesleyan Reformers" separated from the Original Connexion in 1850, in consequence of the expulsion of certain ministers, who refused to repudiate all connexion with certain anonymous [illegible] against certain proceedings of the [illegible]. It is calculated that this proceeding led to the loss of 100,000 members to the connexion. The Reformers, however, do not wish to be regarded as a separate church, or even as an independent connexion, but profess a high regard for the communion from which they consider themselves to have been illegally expelled. Nearly a half of them have, however, as already stated, united themselves with the "Wesleyan Methodist Association." The "Calvinistic Methodists" were the followers of George Whitfield, after he separated from Wesley, on the doctrine of election. The only sects now existing of this class are the Countess of Huntingdon's Connexion and the Welsh Calvinistic Methodists, most of the other congregations having become gradually absorbed into the [illegible] body. The countess of Huntingdon was one of those that were deeply impressed by the preaching of Whitfield, and by his advice she assumed a kind of leadership over his followers, building chapels, appointing preachers, and establishing a college. The doctrines of this connexion are almost identical with those of the Church of England, and the form of worship does not differ materially. In ecclesiastical government, the congregational polity is practically adopted. In 1851, the number of chapels belonging to this connexion was 109, with

38,727 sittings. The "Welsh Calvinistic Methodists" originated from the preaching of one Howel Harris, about 1736. The movement spread very rapidly, and societies were formed, and a system of organization carried out. The "Quarterly Association" corresponds to the Wesleyan Conference, and consists of all the preachers and leaders of societies in the connexion. The preachers are itinerant, and only a certain number of them are ordained to administer the sacraments. Their doctrines are substantially in accordance with the Articles of the Established Church, understood in their Calvinistic sense. The number of their chapels in 1851 was 828, with accommodation for 211,951 persons.

Methyl, *meth'-ile* (Gr. *methu*, wine; *ule*, wood), in Chem., C_2H_3, C_2H_3. The first of the hydrocarbonic radicles of the alcohols. It is a gaseous body, slightly heavier than air, and burning with a bluish flame. It is not liquefied by a cold of 0° Fahr. It is obtained by acting on iodide of methyl with zinc. Its most important compound is methylic alcohol, or wood spirit. It also enters into the composition of the essential oil of *Gaultheria procumbens*, which is a salicylate of the oxide of methyl, and may be prepared artificially by distilling wood spirit with sulphuric and salicylic acids.

Methylated Alcohol, or **Methylated Spirit**, *meth'-e-lai-ted*, spirits of wine to which have been added certain proportions of shell-lac and methylic alcohol, or wood spirit, for rendering the mixture unpotable. The mixture is allowed by the government to be sold without excise duty, for the purposes of manufacture only. Numerous instances have, however, lately occurred in which the methylated spirit has been "doctored" and sold for the purposes of dram-drinking. Methylated spirit is extensively employed as a solvent of resins and gums for varnishes, dyes, [illegible] colours, and for nearly every use to which ordinary alcohol was formerly applied.

Metonic Cycle, *me-ton'-ik*, the cycle of the moon, a period of 19 solar years, after which the new and full moon fall on the same days of the year as they did 19 years before. This cycle was the invention of Meton, a celebrated Athenian philosopher, who flourished about 432 B.C. The Metonic cycle contained 6,940 days, which exceeds the true length of 19 solar years by nine and a half hours nearly. On the other hand, it exceeds the length of 235 lunations, or synodic revolutions of the moon, by seven hours and a half only. The framers of the ecclesiastical calendar altered the distribution of the lunar months when they adopted this cycle, in order to accommodate them to the Julian intercalation. By this alteration, every three periods of 6,940 days were followed by one of 6,939. Consequently, the mean length of the cycle was 6,939¾ days, which coincides exactly with 19 Julian years. In the ecclesiastical calendar, the number of the year in the cycle is called the *golden number*. The cycle is supposed to commence with the year in which the new moon falls on the 1st of January.

Metonymy, *me-ton'-e-me* (Gr. *metonumia*, from *meta*, change, and *onoma*, a name), in Rhet., is a figure of speech by which the name of one thing, or idea, is substituted for that of another, to which it stands in the relationship of cause and effect, container and contained, or sign and thing signified; as when grey hairs are used to denote old age; the cup for the liquor contained in it; the sceptre for regal power.

Metope, *met' o-pe* (Gr. *meta*, between; *ope*, an aperture), in Arch., the square piece or interval between the triglyphs in the Doric frieze. In its original Greek meaning, the word signified the distance between one aperture or hole and another, or between one triglyph and another, the triglyphs being supposed to be solives or joists that fill the apertures. The ancients were in the habit of ornamenting the metopes with carved works or with paintings representing the heads of oxen, vessels, and other objects used in sacrificing. The metope is omitted in the Ionic and Corinthian orders, probably on account of the difficulty experienced in disposing the triglyphs or metopes in symmetrical proportion.

Metre, in versification. (*See* **Prosody**.)

Metric System, *met'-trik*, is the name given to a system of weights and measures at present in use in France, Belgium, Holland, Spain, Italy, Portugal, Greece, and other countries, and which a select committee of the House of Commons has recommended to become legalized in England. This committee, including, among other scientific gentlemen, the astronomer royal, Mr. Fairbairn, the master of the mint, and Professor De Morgan, pronounces the present state of weights and measures a system of legalised disorder, and recommends the adoption of a simple and uniform system, with a view not only to the benefit of our internal trade, but to facilitate our commercial intercourse with foreign countries. The weights and measures of the British empire are enforced, by various acts of parliament, in ten different systems, all of which are in actual use:—1st, Grains divided decimally for scientific purposes; 2nd, Troy weight; 3rd, Bullion weight; 4th, Bankers' weight; 5th, Apothecaries' weight; 6th, Diamond and Pearl weights; 7th, Avoirdupois weight; 8th, Hay and Straw weights; 9th, Wool weight; 10th, Coal weight. Of measures, there are the yard, foot, inch, ell, nail, knot, league; the geographical, Scotch, Irish, and common mile; three sorts of fathoms, &c. Land is measured in the United Kingdom by several sorts of acres; such as the common, Scotch, Irish, &c. In dry measure, twenty different sorts of bushels are used. The price of wheat is in one place at so much the quarter; in others at so much the barrel, sack, bushel, stone, boll, bag, bolt, coomb, hobbet, winch, windle, strike, measure, or weight. A load, a bag, or a stone, varies in nearly every market-town in England. In fluid measures, a pipe varies with each particular sort of spirit or wine it is to contain. A ton of iron is 20 hundredweights; a ton of copper ore is 21 hundredweights; of lead, 19½ hundredweights, and is, in this last instance, termed a fodder. The troy ounce is greater than the avoirdupois ounce, yet the avoirdupois lb. is greater than the troy lb. These are a few out of the interminable mass of perplexities of which the present system is made up. The metre was originally deemed to be the ten-millionth part of the distance from the pole of the earth to the equator, measured along the surface of the sea. In 1799, however, it was declared to be the length of the platinum standard preserved in the archives at Paris. In English measure, its equivalent value is nearly equal to three feet, three inches, and three-eighths of an inch. In the metric system the metre is the fundamental unit of measurement; whence the units of superficies, of capacity, and of weight, are derived. The whole system consists of four principal elements, with their decimal multiples and decimal parts; such as the metre for length, the are for surface, the litre for capacity, and the gram for weight. All these are subdivided into tenth, hundredth, and thousandth parts, which are denominated by the syllables derived from the Latin *deci*, *centi*, and *milli*; the multiples are similarly, by tens, hundreds, thousands, tens of thousands, &c., distinguished by the prefixes, borrowed from the Greek, of *deca*, *hecto*, *kilo*, and *myria*. The subjoined scale shows the whole metric system at a glance:—

Measures of				Proportions.
Length	*Surface*	*Capacity*	*Weight.*	
Millimetre.			Milligram	1,000th part.
Centimetre	Centiare	Centilitre	Centigram	100th part.
Decimetre	(Not used).	Decilitre.	Decigram.	10th part.
Metre.	Are.	Litre.	Gram.	One.
Decametre	Decare.	Decalitre	Decagram.	10 times.
Hectometre.	Hectare.	Hectolitre.	Hectogram	100 times.
Kilometre		Kilolitre.	Kilogram.	1,000 times.
Myriametre.			Myriagram	10,000 times.
			Quintal.	100,000 times.
			Ton.	1,000,000 times

The whole of the multiples and subdivisions of the metric system are decimal, and the reduction from one denomination to the other is performed by multiplying by 10 or its multiples, or dividing by them. There is no necessity to alter the figures, but merely to read them differently by placing the decimal point so many places to the right or left of its place in any given number, according to the terms of the required denomination. For example, if we desire to represent 52749· metres in decimetres we write 527490·; if we wish to reduce it to centimetres we write 5274900·. For the higher denominations we write 5274·9 decametres, or

887·49 hectometres, &c. For measures of capacity and weight the reduction is carried on in precisely the same manner as in that of the metre and its multiples. The annexed equivalents of our present system are useful in comparing scales of either weight or measure. An inch is about 25 millimetres; a foot, 30½ centimetres, or 305 millimetres; a yard, 0·914 metre; a quart, 1·136 litres; a pound, 0·454 kilogram; an acre, 0·405 hectare. It is suggested that the introduction of the decimal coinage should be postponed until the working of the other parts of the metric system has been ascertained. The advocates of the metric system ask for its introduction into the United Kingdom on the ground that our weights and measures being so confused and contradictory, we should adopt such trading medium with other nations as shall enable us to buy and sell according to a simple and substantial plan. The metric system has, it is said, all the qualities that we can desire for our purposes. On the other hand, those who pretend to be sceptical as to the merits of the novel system aver that the metric system, although it has been introduced into France for upwards of half a century, has never been uniformly carried out, either in scientific or commercial calculations, or in ordinary trade transactions. — Ref. *London Review*, vol. xi, No. 156; *The Times*, July 9, 1863.

METRONOME, *met'-ro-nome* (Gr. *metron*, measure, *nome*, division), an instrument employed to mark the time of music, constructed of rosewood or mahogany, in the shape of an obelisk, and nearly a foot in height. There are two kinds: the one rather complicated, having a pendulum kept in motion by means of a spring and wheelwork, while the other is extremely simple, consisting merely of a pendulum without any machinery, which is made to vibrate by striking it with the finger. As early as 1698, an instrument upon a like principle was known in France; but it was not till 1812 that the metronome at present in use was invented, some say by J. N. Maelzel, while others attribute the discovery of the mechanical principle of this instrument to Winkel of Amsterdam, and assert that Maelzel only added the scale of numbers affixed to the pendulum. Although this ingenious little instrument was greatly opposed at its introduction, it is now generally acknowledged to be of great utility both to composers and performers.

METROPOLIS, *me-trop'-o-lis* (Gr. *meter*, mother, and *polis*, city), is the capital or principal city of a country or province, and, as it were, the mother of all the rest. The Roman empire having been divided into thirteen dioceses and 120 provinces, each diocese and each province had its metropolis or chief city, where the proconsul or vicar of the empire had his residence. To this civil division the ecclesiastical was afterwards adapted; and the bishop of the capital city had the direction of affairs, and the pre-eminence over all the bishops of the province. He hence received the name of metropolitan or archbishop. The erection of metropolitans is referred to the end of the 3rd century, and was confirmed by the council of Nice.

METROPOLITAN BUILDING ACTS.—The subject of making general laws to govern the establishment of neighbourhoods would be an interesting study. In all countries, the idea has either never been conceived, or, if considered, not acted upon. Communities have sprung up in an arbitrary manner, commencing, as they must have done, by the erection of a single dwelling. Others have been superadded, and so a neighbourhood has been formed. Each owner has been left to exercise his choice, and the law of property has not been interfered with to check his caprice or personal convenience. In this irregular manner, cities, towns, and other populous districts have been formed. A tenacity of ownership has been inherent in the possessor of his particular domain. The law of every country is jealous of every attempt to disturb a man in the enjoyment of that which is exclusively his own. No legislature will permit this right to be interfered with, except to carry out some plan for the general good or convenience of the people at large. In this country, until very lately, the legislature has not thought it fit or prudent to interfere with private property, and, generally speaking, prohibitory or constraining laws, affecting the same, have been applied only to the metropolis. These were not introduced until the reign of Elizabeth, and they were very limited in their operation. After the fire of London, Sir Christopher Wren suggested a plan for rebuilding the city. If this had been carried into effect, it would have formed the nucleus of a splendid metropolis. Shortly after this fire, viz., in the 19th & 22nd of Charles II., two statutes for regulating buildings in London were passed. These were followed by the act of 6 & 7 Anne. Another statute was passed in the 33 of Geo. II., and some others were enacted in the reign of Geo. III. The chief object of all these was to prevent the spread of fire, and the public health or safety formed little or no ingredient in any law previous to that which is now in operation. This is "the Metropolitan Building Act, 1855," which extends to all places within the limits of the metropolis, as defined by an act of the same session of parliament, intituled *An Act for the better local Management of the Metropolis*. The building act applies to the regulation and supervision of buildings, the structure and thickness of walls, recesses and openings in walls, the timbers in walls, bressummers, height and thickness of parapets and party walls, the construction of [illegible]ds, chimneys, and flues, close fires and pipes, projections, the size of rooms and warehouses, uniting buildings and otherwise. The supervision of these works is intrusted to district surveyors, to whom notice must be given previous to a building or alteration being commenced, who can compel compliance with the act by an order of justices. Power is also given to protect dangerous structures, until application can be made to the owner to do so, and an order can be obtained for the purpose; on failure to comply with which, the commissioners are enabled to pull down and remove the same. This act was amended by an act called "the Metropolitan Building Act (amendment), 1860," which directed that the rules of the former act, as to the cubical dimensions of buildings, [illegible]ld not apply to such as shall be beyond three miles [illegible] St. Paul's, and used for the manufacture of [illegible]hinery and boilers of steam-vessels, provided such [illegible]dings shall consist of one floor only, and be con[illegible] [illegible] therein mentioned. In districts beyond [illegible] of the metropolis, some provisions were made by the act passed in 1847, for consolidating in one act certain prov[illegible] [illegible] cont[illegible]ed in acts for paving, draining, [illegible] improving towns, which to some extent regulates buildings, more especially as to [illegible], setting back houses, [illegible] [illegible] consumption of smoke [illegible] [illegible] supervision of slaughterhouses. This act is incorporated with the Local Government Act, 1858, and is operative in all places under the jurisdiction thereof, and the latter act, in conjunction with the Public Health Act, 1848, applies to whitewashing or cleansing houses, and prohibits the erection of houses over sewers, and establishes authority over the construction and cleansing of drains.

METROSIDEROS, *me'-tro-si-de'-ros* (Gr. *metra*, the heart of a tree; *sideros*, iron), in Bot., a gen. of the nat. ord. *Myrtaceæ*. The clubs and weapons of the South-Sea Islanders are made of the hard wood afforded by various species. The *lignum vitæ*, or *Aki* of New Zealand, belongs to this genus.

MEXICO, ANTIQUITIES OF, *mek'-si-ko*.—The early condition of Mexico has been partly ascertained by means of Mexican pictures, most of which were destroyed by the Spaniards. These pictures contain chronological histories, and copies of many of them were made by the Mexicans shortly before they were destroyed. The most celebrated of these was in the possession of Siguenza y Gongora, professor of mathematics in the university of Mexico in 1698. Although the original is lost, a genuine copy remains, of which Humboldt gives a description. It commences with the deluge of Coxcox, or the fourth destruction of the world according to the Aztec cosmogony. Coxcox and his wife having been saved from drowning, the gift of speech was bestowed on their descendants, and fifteen families arrived in Mexico. Another Mexican author, who wrote shortly after the conquest, divides the history of the world into four great parts:—the age of giants, which lasted 5,206 years; the age of fire, 4,804 years; the age of winds, 4,010; and the age of water, 4,008 years. The Mexican paintings were executed on

skins, cotton cloth, and the leaves of the maguey or agave. When the Spaniards arrived in Mexico, civilization had so far advanced, that, amongst the Aztecs, the right of private property was understood, cities were built, professions and distinctions of rank existed, the arts were cultivated with considerable success, &c. The *teocallis*, or pyramids, are amongst the most remarkable objects of Mexican architecture. The pyramid of Cholula is 177 feet high, and comprises a square of 1,440 feet. It is built of unburnt bricks and clay, and is supposed to have been built by the Toltecs, who preceded the Aztecs. The object of these pyramids is unknown; they are generally truncated, and the larger ones are often surrounded by a number of smaller ones, which are supposed to have been tombs. In the cathedral at Mexico is fixed a circular stone, marked with hieroglyphical figures, by which the Aztecs denoted the months. Not far from it is a stone altar, where human sacrifices were offered up. A large idol is also preserved in the Dominican convent representing a huge serpent devouring a human being. The pyramids of Papantla, near Vera Cruz, are built of large masses of porphyry, and some remarkable antiquities have been of late years discovered at Yucatan.

MEZEREON. (*See* DAPHNE.)

MEZZO, *med'-zo*, literally, half, middle; a term in Music generally employed in composition with some other word; as *mezzo-forte*, moderately loud; *mezzo-piano*, rather soft; *mezzo-soprano*, the middle species of female voice. The C clef, when placed on the second line of the staff, in order to accommodate the mezzo-soprano voice, is termed the *mezzo-soprano* clef.

MEZZOTINTO. (*See* ENGRAVING.)

MI, *mi*, the syllable applied by Guido to the third note of his hexachords. It is expressed in the natural hexachord by the letter E, and is the third note of the major scale.

MIASMA. (*See* MALARIA.)

MICA, *mi'-kă* (from Lat. *mico*, I shine), in Min., a mineral having a somewhat metallic lustre, and capable of being split into thin plates. It enters into the composition of most of the primary rocks. It also occurs in shales, sandstones, and other sedimentary deposits, being derived from the broken-down granitic rocks. It consists chemically of the silicates of potash and alumina, more or less coloured by peroxide of iron. The alumina is often partly replaced by lithia, magnesia, and lime. Mica has lately received important applications in the manufacture of transparent letters for shop-windows and of smoke-shades to gas jets.

MICAH, BOOK OF, *mi'-kă*, is one of the books of the minor prophets in the Old Testament, bearing the name of its author, Micah, who, as we are told, prophesied during the reigns of Jotham, Ahaz, and Hezekiah, and was consequently a contemporary of Isaiah (B.C. 759—699). The book may be divided into three parts. It commences with a majestic exordium, in which is introduced a sublime theophany, the Lord descending from his dwelling-place to judge the nations of the earth, who approach to receive judgment; then follows a prophecy that Samaria shall fall, and that Judah also shall suffer injury and be carried into captivity, followed by a promise of the reunion of the whole people (ch. i. ii.). In the second part the destruction of Jerusalem is foretold, the return of the Jews from Babylon, and the glories of the future Zion, with the advent of the Messiah (iii. 5). The third part consists of a dialogue between the Lord and his people, in which he reproves them for their sins, and threatens them with punishments, ending with the promise of a return from their captivity. The style and ideas of Micah are not unlike those of Isaiah. He is clear and distinct, powerful and animated, rising in many cases to vehemence and sublimity. Micah is the only prophet that pointed out Bethlehem as the birthplace of the future Messiah.

MICE, OR MOUSE FAMILY, *mise* (Ang.-Sax.), a family of rodent mammalia belonging to the order *Glires*. The domestic mouse (*Mus musculus* of Linnæus) has its ears about half the length of the head, the tail a little shorter than the head and body, and the general colour of the upper portions of the body is greyish brown, while that of the lower parts is yellowish grey. The mouse is, in fact, but a small edition of the rat, although its head may be said to be proportionately less elongated than the former species. The body of the mouse is moderately full, the head tapering, the muzzle pointed, the eyes prominent, and the ears broad and rounded, the legs being short, and the feet rather delicate than otherwise. It seems to be entirely dependent on man, as it is never found far from his dwelling. Although naturally timid, mice occasionally exhibit great boldness, and they venture quite close to any one who does not molest them. On account of their fecundity, coupled with their thievish propensities, they are extremely destructive in houses, devouring everything they can get at,—meal, flour, bread, cheese, butter, tallow; in fact nothing edible seems to escape them. Their great enemy is the cat; but even she is unable quite to extirpate them, and thus they do considerable mischief. Their ravages, however, are not confined to houses merely, as they do much damage in farmyards by entering corn-stacks, where they gnaw away to their heart's content. Their enemies, besides man, and the cat and ferret, are weasels, owls of various species, and the kestrel, all of which make the mouse their prey. It has many litters during the year, and from five to seven young ones in each litter; consequently it soon increases considerably if undisturbed. The domestic mouse is common throughout the whole of Europe, and, indeed, has extended to America and Australia. Another variety of the *Murinæ*, the wood-mouse (*Mus sylvaticus*), is likewise found throughout Europe, where it proves a powerful and bitter enemy to the agriculturist. It is generally found in fields and gardens, and it has a habit of piling up large stores of grain, acorns, nuts, and suchlike, as a provision for the winter season. It often takes possession of the deserted holes of moles, where it lays up its magazine. Its ears are about half the length of the head, the tail nearly as long as the head and body; the upper parts reddish brown, and the lower greyish white, with a little orange-red spot on the breast. The harvest mouse (*Mus messorius*) is one of the prettiest varieties of this little animal, and, in fact, it is one of the most elegant of our native quadrupeds. It builds its nest in standing corn, and during the harvest season it is carried into the barns along with the sheaves, in which places it breeds and multiplies in considerable numbers. Its whole length [illegible]t exceed two inches. Its colour is a light reddish brown.

MICHAELMAS, *mik'-l-mis*, is the feast of the archangel Michael, celebrated on the 29th of September. It is one of the regular periods in this country for settling rents.

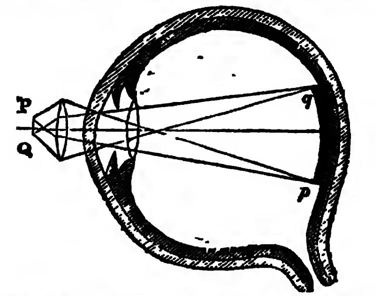
MICROCOSM, *mi'-kro-kozm* (Gr. *mikros*, small, and *kosmos*, world), denotes, literally, a small or little world, and is a term often metaphorically applied to man. Astrologers used to maintain that the organization of man accurately corresponded to the organization of the universe, which they called the macrocosm (Gr. *makros*, great, and *kosmos*). The different parts and limbs of man were made to correspond to the different parts of the universe, and engravings are to be found in works of the time in which man is represented as standing in the centre of the universe, surrounded by lines indicating the various connections of the heavenly bodies with his limbs.

MICROCOSMIC SALT, *mi-kro-koz'-mik*, in Chem., the phosphate of soda and ammonia. It is much used in blowpipe experiments, and is made by dissolving six or seven parts of phosphate of soda and one part of chloride of ammonium in hot water, and allowing the solution to crystallize.

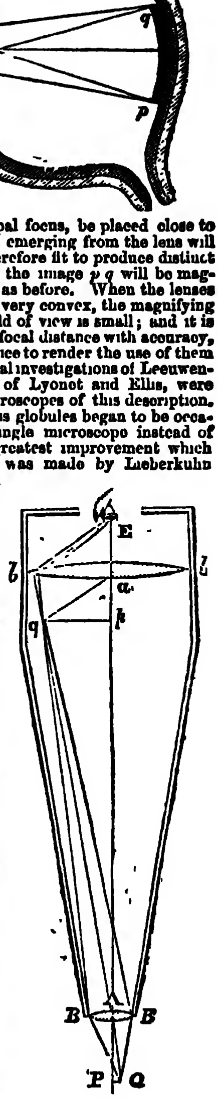
MICROMETER, *mi-krom'-e-ter* (Gr. *mikros*, small; *metron*, a measure), an instrument applied to telescopes and microscopes for the purpose of measuring small spaces or angles with great accuracy or convenience. Numerous contrivances of various kinds, depending on different principles, have been employed for this purpose. Amongst the most useful may be noted— 1. The *wire micrometer*, which is placed in the tube of a telescope at the focus of the object-glass. 2. The *circular micrometer*, consisting of a disc of parallel plate-glass, having in the centre a round hole half an inch in diameter, to the edges of which a ring of steel is cemented. This instrument is conveniently used for comparing the place of a small star or comet with that

of a known star in nearly the same parallel of declination. 3. The *divided object-glass*, or *double image micrometer*. This instrument is formed by dividing the object-glass of the telescope or microscope into two halves, the straight edges being ground smooth, so that they may easily slide by one another. From this instrument being used to estimate the diameter of the sun, it is sometimes called the heliometer. For further information on the subject of the micrometer, the reader is referred to an article on the subject by Sir David Brewster in the *Encyclopædia Britannica*.

MICROSCOPE, *mi'-kros-kope* (Gr. *mikros*, little *skopeo*, I see), an instrument, the purpose of which is to enlarge considerably the images of objects that are either totally invisible or not readily seen with the naked eye. The early history of the microscope, like that of many other scientific instruments, is involved in considerable obscurity, so that not even the time of its discovery, nor the name of its inventor, can be fixed on with any degree of certainty. As the microscope, however, in its simplest form, consisted of little or nothing else than the magnifying power or lens, which must of necessity have been made of glass or some other transparent and highly refracting material, it is evident that its invention may be referred to a period anterior to the Christian era. From a passage in Aristophanes, who lived five centuries before Christ, it would seem that "burning-glasses" were sold at the shops of the grocers of Athens. Several other circumstances tend to show that magnifying-glasses were used by the ancient Greeks and Romans. In the French cabinet of medals there is a seal, said to have belonged to Michael Angelo, the fabrication of which, it is believed, ascends to a very remote epoch, and upon which fifteen figures have been engraved in a circular space of fourteen millimètres in diameter. These figures are not all visible to the naked eye. Mention is also made by Cicero of an Iliad of Homer written upon parchment, which was contained in a nut-shell. Seneca, who was born in the first year of the Christian era and died A.D. 65, in his "Natural Questions," lib. i. cap. 7, says:—"However small and obscure the writing may be, it appears larger and clearer when viewed through a globule of glass filled with water." Pliny, who died A.D. 79, mentions the burning property of lenses made of glass; and Ptolemy, the celebrated astronomer of Alexandria, who flourished in the latter part of the 1st century, was evidently acquainted with the existence of magnifying-glasses, and he makes use of the word refraction in his work on optics. In 1852, at the meeting of the British Association, Sir David Brewster showed a plate of rock crystal, worked into the form of a lens, which had been recently found among the ruins of Nineveh. Sir David maintained that this lens had been destined for optical purposes, and was never used as an article of dress. The lens is now among the Nineveh remains in the British Museum. It is not, however, a difficult matter to fix the period when the microscope began to be generally known, and used for the purpose of examining minute objects. Although we are ignorant of the name of the first inventor, we are acquainted with the names of those who first introduced it to public view. Zachias Jansen and his son are said to have made microscopes before the year 1590; and in 1685, Stelluti published a description of the parts of a bee which he had examined through a microscope. In this country, with the formation of the Royal Society in 1660, a new era of optical science may be said to have commenced; for not only do the early volumes of the Transactions describe new microscopes, but literally teem with improvements in the construction of those instruments, and with discoveries made through their medium. Soon after the invention of the microscope, the field it presented to observation was cultivated by men of the first rank in science, who enriched almost every branch of natural history with the discoveries they made by means of this instrument. The Single, or Simple Microscope, was invented long before the Double, or Compound Microscope: the former will, therefore, first claim our attention. By referring to the articles upon LIGHT and LENS, the reader will be able to understand how an object is magnified by means of a simple microscope. A very small convex lens of short focal length, or a sphere of glass, may be used for magnifying purposes. When an object is placed very near to the eye, a magnified image is formed on the retina; but on account of the too great divergency of the rays, the eye is not able to obtain a distinct perception of the object. If, however, a very small lens, not exceeding in breadth that of the pupil of the eye, and of focal length so short that the object



PQ shall be in its principal focus, be placed close to the eye, the rays of light emerging from the lens will be nearly parallel, and therefore fit to produce distinct vision; at the same time the image $p\,q$ will be magnified to the same extent as before. When the lenses of single microscopes are very convex, the magnifying power is great, but the field of view is small; and it is so difficult to adjust their focal distance with accuracy, that it requires some practice to render the use of them familiar. The microscopical investigations of Leeuwenhook and Swammerdam, of Lyonet and Ellis, were all accomplished with microscopes of this description. About the year 1665, glass globules began to be occasionally applied to the single microscope instead of convex lenses; but the greatest improvement which his instrument received was made by Lieberkuhn in 1710. It consists in placing the small lens in the centre of a highly-polished concave speculum of silver, by means of which a strong light is reflected on the upper surface of an object; thus enabling it to be examined with greater ease and satisfaction. The simple microscope may consist of one, two, or three lenses; but these latter are always so arranged as only to produce the effect of a single lens. In the compound microscope, however, not less than two lenses must be employed,—one to form an inverted image of the object, which, being nearest to the object, is called the *object-glass*; and the other to magnify this image, and, from being nearest to the eye of the observer, called the *eye-glass*. There is every reason to believe that the earliest compound microscopes which were used by Jansen and Galileo consisted of a convex lens for an object-glass, and a concave one for an eye-glass, similar to the telescope in use at that period. In 1618, Fontana used two convex lenses, Dr. Hooke three, and Eustachio Divini four; the two next the eye being plano-convex and placed in contact, with their convex sides towards each other, to give a high power



and a large and flat field. In 1691, Philip Bonani used a compound microscope with three lenses, and added to it an illuminating apparatus with two lenses. The compound refracting microscope, in its simplest form, will be understood by consulting the preceding diagram. BAB′ is a small convex lens, before which, and at a distance from it a little greater than its focal length, if a small object PQ be placed, an inverted image *pq* will be formed of it. The adjustment is such that *pq* is formed in the focus of a convex lens *bab′*, and therefore the rays, after being reflected through it, are parallel when they emerge, and consequently in a state fit to produce distinct vision. An eye, therefore, placed at E will see a magnified image of PQ at *pq*. The reflecting compound microscope was first suggested by Sir Isaac Newton, and its construction varied and rendered more complex by Dr. Barker and Dr. Smith, of Cambridge. In 1738, Lieberkuhn's invention of the solar microscope was communicated to the public; and since that time the microscope and microscopic science have made rapid advance. In 1812, Dr. Wollaston proposed a very useful form of the instrument, called by him the periscopic microscope, in which two hemispherical lenses were cemented together by their plane surfaces, having a stop between them to limit the aperture. A similar proposal was made by Sir David Brewster in 1820, who achieved his result by cutting a groove in a whole sphere and filling the groove with opaque matter. Seven years previously, Sir David had first pointed out the lasting value of precious stones, such as the diamond, ruby, garnet, &c., for the construction of microscopes. Lenses of glass undergo decomposition and lose their polish in course of time. At the same period, the subject of achromatism engaged the attention of some of the most profound mathematicians in England. From that time the manufacture of the achromatic compound microscope in this country rapidly improved, and the instruments now made in London are unequalled in any part of the world. The mode in which the microscope is usually mounted will be seen by the accompanying illustration

of an ordinary student's microscope. In all the mechanism connected with it, the principal requirement is steadiness, or freedom from vibrations not equally communicated to the object under examination and to the lenses by which it is viewed. The investigation of the minute structure of animals and plants by means of the microscope may be truly said to be the creation of this century, notwithstanding the previous discoveries of Leeuwenhoek, Malpighi, Hooke, and others. During the greater part of the 18th century, except as a mere toy, the microscope fell into disuse; nor was it till within the last thirty years that it was really rendered capable of yielding such a magnifying power, together with such clearness of definition, as is necessary for the investigation of the science of histology. One of the principal results of microscopic research is, that a closer unity of organization has been found to exist among the minute structures of organized beings than among the larger organs. In organized beings, Nature works out her most secret processes by structures far too minute for observation with the unassisted eye. Hence we find that the best modern books on human an[illegible] [illegible]gy are filled with descriptions [illegible] structures. The processes of secretion, of nutrition, of generation, and even the mysterious action of the brain and nervous system, unintelligible, save in their results, by the means formerly employed, are now being gradually evolved by the labours of microscopic physiologists. Among those who have employed the microscope not only with the greatest assiduity but with the utmost benefits to science and to their fellow-creatures, have been the members of the medical profession. An extended microscopic examination has also shown that animals and plants gradually approach each other as we descend in the scale, until they meet in a common centre,—the simple or individual cell. At this point, all means of distinguishing between vegetable and animal organism end, and no feature exists which, in the present state of science, can enable any one to determine to which of the two kingdoms the individual cell belongs. One of the chief distinctions between the elementary tissues of plants and animals is, that while in the plant the cell, however modified in form, still possesses all the characters of a cell, in the animal it usually undergoes a development into tissues, in which the cellular form entirely disappears. —*Ref* Quekett's *Lectures on Histology*, and *Practical Treatise on the Use of the Microscope*; *The Microscope and its Revelations*, by W B. Carpenter.

MIDDLE AGES, *mid′-dl*, is that period in the history of Europe which begins with the final destruction of the Roman empire, and is considered, by some, to end with the [illegible] of Constantinople; by others, with the R[illegible], [illegible] of A[illegible]ca, or the invention of printing. [illegible] Hallam, who has written a history of this period, it extends from the invasion of France by Clovis, A.D. 480, to that of Naples by Charles VIII, 1495. In any case, it comprises a period of about ten centuries. In general, it was that period in the history of Europe in which the feudal system was established and developed down to the most prominent events which led to its overthrow. The first centuries of this period are often called the Dark Ages, a name not inappropriate when we consider the condition of the barbarous tribes by whom Roman institutions were overthrown. The acquisitions of civilization were ruthlessly trampled under foot by barbarous warriors, and the civil development of society, which had been the work of ages, received a severe check. It is more than doubtful, however, whether civilization has in the long run been a loser by this state of things. The civilization of Rome was degenerate and rotten to an enormous extent, while those rude and ruthless barbarians afforded materials for carrying on a more healthy and permanent state of advancement. "The first moiety of these ten ages," says Hallam, "is almost absolutely barren, and presents little but a catalogue of evils. The subversion of the Roman empire and devastation of its provinces by barbarous nations, either immediately preceded, or were coincident with, the commencement of the middle period We begin in darkness and calamity; and though the shadows grow fainter as we advance, yet we are to break off our pursuit as the morning breathes upon us and the twilight reddens into the lustre of day. No circumstance is so prominent on the first survey of society during the earlier centuries of this period as the depth of ignorance in which it was immersed; and from this, more than any single cause, the moral and social evils which those ages experienced appear to have been derived and perpetuated." When Latin ceased to be a living language, the whole treasury of knowledge was locked up from the eyes of the people. The schools were confined to cathedrals and monasteries, and exclusively designed for the purposes of religion; so that for centuries it was rare for a layman, of whatever rank, to know how to sign his name. Even

the clergy were, for a long period, not very materially superior as a body to the uninstructed laity. Whatever of learning existed, however, was to be found within the pale of the Church, which, indeed, was pretty extensive, and comprehended many who did not exercise the offices of religious ministry. In the 6th century the best writers in Latin were scarcely read; and perhaps from the middle of this age to the 11th there was, in a general view of literature, little difference to be discerned. With such a state of society it cannot be doubted that morality was at a very low ebb. The seeds of social virtues must have existed even during the darkest time of this period; but history, which reflects only the more prominent features of society, affords us but little evidence of it. These remarks apply more particularly to the dark ages of the period, which may be considered to come down to the end of the 11th century. In the course of the 12th century a considerable change took place. Polite literature, as well as the abstruser science of antiquity, became the subject of cultivation; and several writers of that age, in different parts of Europe, are distinguished, more or less, for elegance, though not absolute purity of Latin style, and for their acquaintance with those ancients who are its principal models. In the 13th century there seems to have been some decline of classical literature, in consequence, probably, of the scholastic philosophy which was then in its greatest vigour; at least we do not find as many good writers as in the preceding age. But about the middle of the 14th century, or perhaps a little sooner, an ardent zeal for the restoration of ancient learning began to manifest itself. The copying of books rose to be a branch of trade, and their price was consequently reduced. A search now began to be made for ancient manuscripts, in which Petrarch particularly distinguished himself. In the succeeding centuries this zeal was carried on with unabated vigour, and the whole lives of Italian scholars were devoted to the recovery of manuscripts and the revival of philology. The discovery of an unknown manuscript, says Tiraboschi, was regarded almost as the conquest of a kingdom. During the 14th and 15th centuries colleges began to be established in Germany, England, and other parts of Europe, libraries became more numerous, and books, after the happy invention of paper, though still very scarce, might be copied at less expense. Last of all, the invention of printing, about the middle of the 15th century, was the great means of dispelling the ignorance and darkness of the middle ages, and of introducing the dawn of civilization of modern times. During this latter period, the moral character of society was much improved, owing, in no small degree, to the advance of chivalry; commerce and the manufactures made great progress; the use of the popular languages became more general, and greater freedom of thought in religious matters began to manifest itself. —*Ref.* Hallam's *Europe during the Middle Ages.*

Midge, *mij* (Sax. *mygge*), a dipterous insect, belonging to the genus *Chironomus*, of the family *Tipulidæ*. It frequents marshy situations, and has a good many points of resemblance to the gnat. The proboscis is short, thick, and ends in two large fleshy lips; the antennæ are longer than the head, and are simple, being rarely pectinate; the palpi are longer than the proboscis, the eyes acute, and the ocelli wanting. The body and legs are long and slender, the wings narrow and elongate, and the halteres, or balancers, are naked, and proportionately longer than those of the diptera. In their flight, midges can be seen continually moving about in the air during the autumn, and they ascend and descend in a vertical line with a humming, buzzing noise.

Midsummer Day, *mid-sum'-mer*, is the festival of St. John the Baptist, held on the 24th of June. It was long the custom in this country to kindle fires at midnight on Midsummer eve in honour of the summer solstice.

Mignonette. (*See* Reseda.)

Migration of Birds. (*See* Birds.)

Mildew, *mil'-dew* (Sax. *mildeaw*), the term applied to the thin whitish coating sometimes found on the leaves of vegetables, on paper, cloth, &c. It consists of innumerable minute fungi. The mildew of wheat is produced by the fungus called *Puccinia graminis.*

Mile, *mile* (Lat. *mille passus*, a thousand paces).—Amongst the ancient Romans, each pace was five feet, and each foot contained about 11·62 modern English inches. At this calculation, each Roman mile contained 1,614 yards, or nearly nine-tenths and one-sixtieth of an English mile. The English statute mile is 8 furlongs, each of 220 yards; or 40 poles of 5½ yards or 16½ feet each. It is, consequently, 1,760 yards, or 5,280 feet. It would appear that the English statute mile was defined incidentally in the 35th year of Queen Elizabeth's reign. An act was then passed, by which persons were forbidden to build within three miles of London. In that statute, the mile was declared to be "8 furlongs of 40 perches, of 16½ feet each." In nearly every country of Europe, the mile is used as an itinerary measure, particularly in those countries which at one time were subject to the Romans. Its length, however, varies greatly among different nations, and in some countries has evidently become confounded with the Celtic *league*. The following list will show the difference between the principal European miles:—

Yards.		*Stat. miles*
1,760	English statute mile	1·000
1,614	Ancient Roman mile	·917
1,628	Modern Roman mile	·925
1,984	Ancient Scottish mile	1·127
2,240	Irish mile	1·273
4,263	French posting league	2·422
4,860	French league of 25 to the degree	2·761
4,635	Spanish judicial league	2·634
6,760	Portuguese league......................	3·841
10,126	German long mile	5·753
6,859	German short mile	3·897
8,244	Danish mile	4·684
11,700	Swedish mile	6·613

In France, Italy, and the Netherlands, the metrical mile of 1,000 French mètres, or 1,093 English yards, is used. The geographical mile, or the sixtieth of a degree of latitude, or about 2,025 yards, is used in England and Italy. The geographical league of three such miles, or 6,075 yards, is used in England and France. In Germany, the geographical mile is four English geographical miles, or 8,100 yards, which is also the length of the mile in Holland. The Arabian mile is 2,148 yards; the Chinese *li* 632 yards; the Persian *parasang*, 6,086 yards; the Russian *verst*, 1,167 yards, and the Turkish *berri*, 1,826 yards.—*Ref.* Kelly's *Cambist*; and the *English Cyclopædia*—article Mile.

Military Education. (*See* Education, Military.)

Military Schools are establishments in which soldiers are instructed, or youths educated for the army. The *soldier schools* of Prussia belong to the first of these classes, and are the most remarkable; they are established in every regiment or battalion, and in them the privates are taught the rudimentary branches of education, and sometimes agriculture. Military schools of a similar kind exist in the British, Austrian, and other European armies. Institutions of the second class, intended for the education of officers, have been in existence since the days of antiquity, and now form an indispensable part of the military system of all great nations. Louis XV. founded the first military school in France in 1751; it had 500 pupils, all of whom were young noblemen. In 1808, Bonaparte founded the celebrated school of St. Cyr, which still retains the principal features of its first organization. Before the Seven Years' war, the French had established artillery schools in every town where a regiment of that arm was garrisoned. In Prussia, the education of officers is provided for by high schools for each arm in every division of the army; and by the Royal Military School, founded by Frederick the Great, to which the most deserving young officers are admitted from the line. In this country, the military schools which hold the highest reputation are the Royal Military College at Sandhurst, which comprises a cadets' college and a staff college (*see* Cadet, Military), and the Royal Military Academy at Woolwich, designed as an artillery and engineer school. The Addiscombe Military College was established by the East-India Company for the education of cadets for their own army. The best-known military academy

in the North American States is that at West Point, founded in 1802. Cadets are admitted on the recommendation of members of congress and the president. The number of cadets is limited to 250. The education and subsistence are gratuitous, but the graduates are expected to spend eight years in the public service.

MILITIA, *mil-ish'-yă* (Lat. *miles*, a soldier), a term employed to distinguish from the regular forces a body of citizens who may be called out for a limited time, and embodied as soldiers on occasion of emergency. Under different names, such an establishment exists in most European countries. In this country, after the Norman conquest, the proprietors of land were compelled to contribute to the defence of the realm in the event of a threatened invasion, by providing men and arms in proportion to their estates. The troops were raised under the authority of "commissions of array," which were issued by the crown. At first, the militia seem to have been liable to be marched to any part of the kingdom, when required; but in Edward the Third's reign it was decreed that no militia-man should be sent out of his county except in time of public danger. From the reign of Philip & Mary, the lords lieutenant have had the charge, under the sovereign, of raising the militia in their various counties. After the celebrated dispute between Charles I. and the parliament, regarding the right to command the militia, it was decreed at the Restoration, that "the sole supreme government, command, and disposition of the militia, and of all forces by sea and land, and of all forts and places of strength, is, and by the laws of England ever was, the undoubted right of his majesty (Charles II.) and his royal predecessors." In 1757, a bill was passed by which the militia was reconstructed; and in 1802 the militia laws of England and Scotland were consolidated by 42nd Geo. III. c. 90 and 91. New regulations were passed in the 15th, 16th, 17th, 18th, and 19th Vict., which contain the law applicable to the militia at present. By the constitution of the militia in the United Kingdom, the sovereign appoints lords lieutenant in Britain, and governors in Ireland, to each county or province, with power to call out and train the militia annually; and to appoint deputy-lieutenants or deputy-governors, and other officers, subject to the royal approval. All persons not labouring under bodily infirmity, and not specially excepted, are liable to be chosen by ballot as militia-men; and are compelled, under a £10 penalty, either to serve or provide a substitute. The persons excepted, are—peers of the realm, commissioned and non-commissioned officers and privates in the regular forces, half-pay officers in the army, navy, and marines; and commissioned officers who have served four years in the militia; members of corps of yeomanry or volunteers; seamen and persons doing duty at the royal docks, at the gun-wharfs and powder-magazines; also persons employed under the Board of Ordnance; resident members of the universities; clergymen of the Established Church; constables, articled clerks, apprentices, and some others. The militia is trained and exercised twice a year, and during fourteen days each time; or once in a year, for twenty-eight days, at the discretion of the lords lieutenant or their deputies. During the war with Russia, in 1855, the whole of the militia in England, Scotland, and Ireland, amounted to 61,754. Within a month, this number decreased to 51,183; but during that time 19,150 had volunteered into the line.

MILK, *milk* (Sax. *meolc*), an opaque whitish secretion peculiar to the females of the class *Mammalia*, or those animals which feed their young from their teats. Milk differs as procured from various animals, but its general characteristics are the same in all. The most familiar variety is that of the cow. Milk may be looked upon as a serous fluid, holding in suspension minute white globules, composed of casein and fatty matter. When examined microscopically, these globules are found to have a diameter of ·00039 inch, and to disappear on the addition of a solution of potash.—(*Raspail.*) According to the researches of Professor Nasse, of Marburg, milk is thus constituted:—1st. Smooth, homogeneous, transparent oil-globules, and large oil-globules, also the common milk-globules; 2nd. cream-globules, distinguishable by their facette-like appearance; 3rd. granulated yellow corpuscles; 4th. the lamellæ of the epithelium; 5th. the more or less turbid medium in which the four preceding kind of corpuscles are suspended. When milk is allowed to stand for some time, it undergoes spontaneous changes; a thick yellowish substance, called *cream*, collects on the surface, and the milk beneath becomes thinner and of a pale bluish colour. Butter, buttermilk, and cream-cheese, are made from cream by processes which will be found described under the articles on BUTTER and CREAM. Milk from which butter has been taken also undergoes spontaneous changes; it becomes much sourer, and congeals into a mass of the consistency of jelly. The fermentation of this coagulated mass is hastened by heat; and when certain substances are added it very rapidly takes place. Thus, acids and spirits of wine *curdle* it, as it is called; but the most powerful coagulator in use is a decoction from the stomach of animals, especially that of a calf, called *rennet*. After being thus treated, if the whole is put into a bag and squeezed, a thin fluid is forced out, and a tough whitish matter is left behind: the latter substance is called *curd*, and the former *whey*. (*See* CHEESE.) According to Berzelius, the specific gravity of milk is 1·033; that of cream, 1·024; and their composition is,—

Skimmed Milk.

Water	928·75
Caseous matter, or curd, with a trace of butter	28·00
Sugar of milk	35·00
Hydrochlorate and phosphate of potash	1·95
Lactic acid, acetate of potash, and a trace of lactate of iron	6·00
Earthy phosphates	·30
	1000 00

Cream.

Water	920·00
Curd	35·00
Butter	45·00
	1000 00

The statements respecting the composition of human milk are [illegible], owing, probably, to the difficulty of obtaining it in sufficient quantity for analysis, and also from its mutability in regard to the relative proportions of the component parts. Its specific gravity, however, appears to vary between 1·020 and 1·025; and its solid contents, according to M[illegible]hofer, vary between 11 and 12·5 per cent. The milk of cows and other animals is very much used as food, and is very important as a constituent of diet, even among adults. It is also valuable as a food for invalids, especially those who have a consumptive tendency. In some cases of poisoning by metallic salts, such as corrosive sublimate, sulphate of copper, &c., milk is used as an antidote. By evaporating to dryness and powdering, milk can be brought into a condition in which it will keep for a length of time. In this state an artificial milk can be formed by dissolving the powder in tepid water, which is useful in sea voyages, especially for children. Within late years considerable progress has been made in treating milk so as to render it capable of keeping for a length of time. Moore's essence of milk is made by evaporating the milk first in long shallow copper vessels, heated by steam to 110° Fahr.; during this process, which continues for four hours, a little sugar is added, and the liquid is frequently stirred. By evaporation the milk loses three-fourths of its bulk, and the remainder, as a very thick cream, is put into small tin cases, soldered down, steeped in boiling water for a short time, and then allowed to cool. This essence of milk will keep good for a length of time. Various other forms of preserved milk are known. Grimwade's desiccated milk, used by Miss Florence Nightingale in the Balaclava and Scutari hospitals, is made by mixing the milk with a little sugar and alkali. After the mixture has been heated over hot water till it is of the consistency of dough, it is dried into hard cakes, crushed between strong rollers, and bottled. At the Aberdeen meeting of the British Association in 1859, four kinds of preserved milk were exhibited by the Abbé Moigno. One of these, prepared by putting milk into a vessel, excluding

the air, and exposing it to a steam atmosphere of 100° centigrade, and then packing in bottles, was perfectly sweet and fresh after five and a half years' keeping. All processes for preserving milk require great care and precision.

MILKY WAY, *mil'-ke*, an appellation bestowed in Astron. upon a whitish zone of light which everybody must have observed in the sky. This zone makes a complete tour of the heavens, passing through the following constellations:—Cassiopeia, Perseus, Gemini, Orion, Monoceros, Argo, the Southern Cross, the Centaur, Ophiuchus, Serpens, Aquila, Sagitta, Cygnus, and Cepheus. The milky way thus traces almost a great circle of the celestial sphere; whence results a secondary arc, which, after separating from the principal arc throughout an extent of about 120° from *a* Centauri to Cygnus, becomes again confounded with it. Concerning the milky way Sir William Herschel says:—"This remarkable belt has maintained, from the earliest ages, the same relative situation among the stars; and when examined through a powerful telescope is found (wonderful to relate!) *to consist entirely of stars scattered by billions*, like glittering dust on the black ground of the general heavens." So crowded are the stars in some parts of the milky-way, that the same astronomer, by counting the stars in a single field of his telescope, was led to conclude that 50,000 had passed under his view in a zone two degrees in breadth during one hour's observation. The milky way was called by the Greeks *galaxias*; from which we derive our word galaxy. The Chinese and the Arabians call it the Celestial River; it is the path of the spirits among the savages of North America, and the path of St James of Compostella according to the peasants of Italy. According to the ancient Greeks, the galaxy arose from the milk which the infant Hercules let fall from the breast of Juno when she pushed him away, on learning that he was the son of Maia: others considered that it was not milk, but ears of corn which Isis dropped on her flight from Typhon. Some of the Pythagoreans believed it to be an old and disused path of the sun: Anaxagoras thought it was the reflection of the earth; and Aristotle considered it sublunary, and consisting of exhalations of the same matter as comets. Although Democritus hit upon the true solution of the difficulty, it was not till the discovery of the telescope that Galileo was enabled to announce that he had resolved the whole of the milky way into stars. It is calculated that the light from the nearest stars in the milky way employs about three years in reaching the earth; the light of the most distant will not arrive at the earth in less than 1,500 years.

MILL, *mill* (Lat. *mola*, Gr. *mule*), originally a machine used for dividing, crushing, or pulverizing any substance; but more extensively applied in modern times to almost all machinery consisting of wheel-work, whether intended to change the form or the position of the object to be operated upon. Machines of this kind, therefore, take their name from the processes for which they are used,—as saw-mills, stamping-mills, fulling-mills, [illegible] power,—as wind-[illegible], [illegible], steam-mills, hand-mills, &c.; or from the material operated on,—as cotton-mills, sugar-mills, flour-mills, oil-mills, &c. These different kinds of mills will be found described under the articles to which they refer. One of the earliest uses of the mill was the grinding of corn. Among the rudest nations, this was done by pounding it between two stones. With the advance of art, however, a simple hand-mill was constructed, composed of an immovable nether stone, called the *mola*, and [illegible] upper stone, called *mulos*, put in motion by the hand. These mills were used by the Hebrews and Greeks, and were commonly worked by criminals or slaves. Asses were afterwards employed. Water-mills appear to have been used by the Romans, and the wind-mill was invented in the reign of Augustus. At the present day, the ordinary mill for grinding grain is constructed with two circular stones, made of buhr or burr-stone, syenite or granite, placed horizontally. (*See* FLOUR-MILLS, and BUHR- or BURR-STONE.)

MILLBANK PRISON, *mil'-bânk*, is a prison situate on the Middlesex shore of the Thames, and lying between Lambeth and Vauxhall bridges, for the reception of convicts under sentence or order of transportation, to be there confined until the sentence or order shall be executed, or until the convict be entitled to freedom, or removed to some other place of confinement. It is placed under the authority of certain of the inspectors of prisons appointed for that purpose, who form a body corporate under the name of the "Inspectors of the Millbank prison," and who report yearly to one of the principal secretaries of state on all matters relating to the prison.

MILLENARIANS. (*See* next art.)

MILLENNIUM, *mil-len'-e-um* (Lat. *mille*, a thousand; *anni*, years), is a term applied by ecclesiastical writers to that period predicted in Scripture when Christ is to reign with his saints upon earth for the space of one thousand years (Rev. xx.). Many have held, from the earliest period of Christianity, that this is to be received literally, and have drawn up ideas of this earthly paradise. Those who hold this doctrine are commonly called millennarians. The ancient millennarians held that the city and temple of Jerusalem were to be rebuilt and splendidly adorned with gold and jewels, and that Christ, having come down from heaven, would reign there a thousand years with his saints, both those who were already dead and those who were still alive. The productions of nature were to be prodigiously increased, and everything in nature was to minister to their corporeal delights. The Jews were to be restored to their own land, and raised to the first rank among the nations of the earth. Irenæus and others of the early fathers held these views; but they were warmly opposed by Origen and others. These maintained that the passages founded upon were to be understood [illegible] to a period when Christianity [illegible] world; and in consequence, physical and moral evil abated. The latter is now the view generally held; but some, as the Irvingites, still look for a personal reign of Christ upon earth.

MILLET, *mil'-let* (Fr.), the common name for a great number of cereal plants, the grains of which are used as food and for making a kind of beer, in various countries. *Holcus Sorghum* is the Turkish millet; *Panicum miliaceum*, the Indian; *Paspalum exile*, the Sierra Leone; *Setaria germanica* and *italica* the German and Italian millet respectively.

MILL-STONE GRIT, in Geol., a group of strata, consisting of coarse-grained quartzose sandstone, which occurs between the mountain limestone and the superincumbent coal formations.

MIMOSEÆ, *mi-mo'-ze-e*, in Bot., a sub-ord. of the *Leguminosæ* or Bean fam., characterized by the petals being equal and valvate in æstivation. The plants included in this sub-order are mostly natives of tropical regions, and are remarkable for yielding gum and astringent principles. (*See* ACACIA.)

MINARET, *min-â-ret'* (Arab. *menarah*, a lantern), in Eastern architecture, a slender and lofty turret, with one or more projecting balconies around it, which divide it externally into several stories. In Mohammedan countries, the minaret is used for the purpose of calling the people to prayers. Generally, however, they are more numerous than this purpose requires; there being usually one at each angle of the building, and sometimes a greater number. By this means they become highly characteristic features of the architecture, not only on account of their frequency, but also from their tall, graceful, column-like shape, which contrasts well with the cupolas which generally crown the edifices. The exterior carving of some of the minarets in India, such as that in the mosque at Ahmedabad, is profuse in its splendour; but the outline of the [illegible] is usually more picturesque.

MINE, *mine* (Fr.).—In its strict sense, a mine is an opening in the ground from which anything is dug. The name is not properly applied until an opening is made; although now, the term is generally used to signify coal, lead, iron, and similar minerals before an opening is made for digging them out. In opposition to the underground works, which constitute the mine properly so called, the term usually comprehends all [illegible] on the surface, together with the steam-engines, water-wheels, and other machinery and appendages for drainage, the extraction of ores and their mechanical preparation, with various buildings and

erections. From the earliest antiquity, the art of mining has been practised, and it has formed a branch of industry in the most barbarous, as well as the most civilized countries. In this country, mining had a very early origin; and it was most probably the first source of trade to the British islands. The tin from the English mines was so celebrated that the Phœnicians traded to Cornwall for this metal. In Law, mines belong to the tenant in fee simple of the land, except in the case of gold and silver mines, which are the property of the king by his prerogative. In Mil. engineering, a mine is a subterraneous passage leading to a chamber intended to be blown up by gunpowder. (*See* MINING.)

MINERALOGY, *min-e-răl'-o-je* (Fr. *minéral*, and Gr. *logos*, discourse), "A science which describes the kinds of mineral material forming the surface of our planet, points out the various methods of distinguishing minerals, makes known their uses, and explains their mode of occurrence in the earth"—(*Dana.*) The best method of acquiring this important science is by attentively studying the different specimens of minerals existing in our museums, more especially those at the British Museum and Museum of Economic Geology. They should be examined in company with some experienced mineralogist, or else with the assistance of the manuals of Dana, Nicol, or Philips. When the student has made himself pretty well acquainted with the external characters of the leading minerals, the work of collection should commence—hammer and book in hand. If, however, mineral districts cannot be visited, the student should procure from some friend, or professional mineralogist, a number of unnamed minerals. These should be made out and named by means of their hardness, fracture, colour, lustre, blowpipe reactions, and, if necessary, by chemical analysis. Too many young mineralogists begin the work of collection long before they have any knowledge of the specimens they accumulate. By this means a mass of useless rubbish is got together, which is only an encumbrance to the student. The science of mineralogy is still in a very unsatisfactory state, mineralogists having hardly agreed as to a system of classification. That of Dana is, perhaps, the simplest. The science is also, unfortunately, encumbered with numberless synonymes and so-called species, the same mineral being known under several different names. Of late years, too, a most unphilosophical method of nomenclature has gained ground. Instead of naming a new mineral after its leading characteristic, or at any rate after the locality in which it is found, the discoverer generally manufactures some such name as Smithite, or Brownite, either after himself or some eminent man whom he wishes to honour.

MINERAL WATERS, *min'-e-ral.*—From the powerfully solvent properties of rain-water, that fluid no sooner reaches the ground and percolates through the soil, than it dissolves some of the substances with which it meets in its passage. Under ordinary circumstances, however, it takes up so small a quantity of soluble substances that their presence does not materially affect its sensible properties: in this state it is known by the names of *river*, *spring*, and *well* water. On some occasions, however, it becomes so strongly impregnated with saline and other substances, that it acquires a peculiar flavour, and is thus rendered unfit for ordinary domestic duties: it is then known by the name of *mineral water*. The different kinds of mineral water may be arranged in six divisions; namely, Acidulous, Alkaline, Chalybeate, Sulphureous, Saline, and Silicious springs.—1. *Acidulous springs*, of which those of Seltzer, Spa, Pyrmont, and Carlsbad are the best known, generally owe their acidity to the presence of free carbonic acid. When poured from one vessel into another, they sparkle, in consequence of the escape of carbonic acid gas.—2. *Alkaline waters*, or those which contain a free or carbonated alkali, either in their natural state or when concentrated by evaporation. These springs are rare; but some are found at St. Michael's, in the Azores. The water contains carbonate of soda and carbonic acid, and is almost entirely free from earthy substances.—3. *Chalybeate waters*, which are characterized by a strong, styptic, inky taste, and by producing a black colour when mixed with an infusion of gall-nuts. The iron contained in these waters is most frequently in the form of protocarbonate held in solution by free carbonic acid. On exposure to the air, the protoxide is oxidized, and the hydrated peroxide descends, leaving the reddish-yellow deposit ordinarily observed in the neighbourhood of chalybeate springs. Waters of this kind are not uncommon. The most noted in this country are those of Tunbridge, Cheltenham, and Brighton.—4. *Sulphureous waters* contain hydrosulphuric acid, and may easily be recognized by their odour. They also cause a brown precipitate when mixed with a salt of lead or silver. The springs of Aix-la-Chapelle, Harrowgate, and Moffat, afford examples of sulphureous waters.—5. *Saline springs* derive their characters from saline compounds held in solution. The salts which are most frequently contained in these waters are the sulphates and carbonates of lime, magnesia, and soda, and the chlorides of calcium, magnesium, and sodium. In a few, potash is found; and Berzelius discovered lithia in the spring of Carlsbad. Among instances of saline springs may be mentioned those of Epsom, Cheltenham, Bath, Bristol, Barèges, Buxton, Pitcaithly, and Toeplitz. Sea-water may be regarded as one of the saline mineral waters. The water of the Dead Sea, however, possesses a far stronger saline impregnation than sea-water, as it contains one-fourth of its weight of solid matter. It has a peculiarly bitter, saline, and pungent taste, and its specific gravity is 1·211.—6. *Silicious waters* are very rare, and in those hitherto discovered the silica appears to have been dissolved by means of soda. The most remarkable of these are the boiling-springs of the Geyser and Rykum, in Iceland. (*See* GEYSER.) The term mineral waters is sometimes applied to those springs which have no claim to repute except for their extreme purity; such as those of Malvern and Holywell.

MINIATURE, *min'-e-ā-ture* (Fr.), a picture or a representation of nature on a very small scale. In the ordinary acceptation of the term, the word miniature includes two widely different kinds of painting. Of these, one is that ornamental painting or illuminating which is seen in its highest perfection in Mediæval bibles, psalters, missals, and other costly manuscripts on vellum, the other kind is that of minute or diminutive portraits generally painted on ivory, to which, in popular language, the word has been confined exclusively in late years. The first kind of miniature is of very ancient origin: they are to be seen among the hieroglyphics of the Egyptians. The books of the ancient Romans were often decorated with small paintings in a costly style. The oldest existing manuscripts with miniatures are Byzantine, and of the latter part of the 4th or beginning of the 5th century. The manner of the Byzantine miniatures was closely imitated in the Italian monasteries as late as the 13th century; but early in the 15th century the works produced by the Italian monks assumed a higher place than that of their Greek masters. The earliest school of miniature-painters in the West of Europe seems to have been that founded at Finan, in Ireland, in the first half of the 6th century, by St. Columba. There is great diversity in the miniature-painting of different ages and countries, not only in style, but in the methods of execution. They were generally painted on vellum or paper, with colours very finely levigated and rendered opaque by being—for the shadows as well as the lights—mixed with white; the usual vehicle being gum, glue, or white of egg. Gold was also freely used, gold backgrounds being frequent at most periods. The second class of *miniatures* includes the small portraits painted either for decorative purposes or to place in cabinets, lockets, or brooches. Ivory was adopted for this purpose at an early date; it was found to form a more suitable ground than vellum for independent works, and its adoption led to a change in the technical processes. The ivory required for miniatures is cut into very thin sheets, and when mounted is backed up with some very white material. The painting is executed in water-colours, and the flesh-tints and other parts requiring great delicacy of finish are entirely, dotted, stippled, or hatched upon the surface. Art in miniature-painting has been successfully prosecuted in England. One of the first was Nicholas Hillard, limner to Queen Elizabeth; and this country

has always taken its stand above the continental nations in its miniatures. In late years, however, the art seems to have entirely succumbed before the rapid advance of photography.

MINIM, *min'-im*, a character or note employed in Music, equal in duration to half a semibreve, or two crotchets.

MINING, *mi'-ning*, is the art of discovering and extracting metals, metallic ores, or other mineral produce from the earth, by means of subterranean excavations. Generally speaking, mineral produce lies in veins, or layers, beneath the surface of the earth. The miner, in order to reach them, sinks a vertical pit, or shaft, in such a manner as to cut the vein or layer, which is suspected to exist either from the well-known nature of the district, or from part of it making its appearance at the surface. Occasionally, it happens that the mineral forms part of the regular strata of the country. Thus, in Staffordshire, we find thin bands or seams of coal, ironstone, and limestone, varying in thickness from a few inches to several feet, and extending over many square miles of country. Usually, however, metalliferous mineral matter is found in fissures, which traverse the ordinary strata of the district. These fissures, when filled with granite, trachyte, or other igneous rocks, are termed *dykes*, but when they contain metallic ores, they are called *veins*, or *lodes*. The business, then, of the miner is to follow these lodes as far as possible. As soon as the shaft is sunk, and the lode is reached, a horizontal gallery or level is driven right and left in the direction of the lode,—the ore being conveyed to the shaft and thence by buckets or kibbles to the surface. If the lode is pretty rich, and the strata give indications of the existence of other veins, more shafts are sunk, and levels driven. As might be expected, the lodes often differ considerably in thickness even within the length of a few yards. Sometimes they dwindle away altogether, and at others disappear suddenly by the subsidence or dropping down of the strata. In the latter case, the miner drives several levels in different directions, until the broken lode is found once more. One of the greatest difficulties with which the miner has to contend is water, which often oozes into the mine in all directions. When the mine is situated on the side of a hill, it is simply necessary to open an adit-level at the lowest part of the hill-side, to serve as a watercourse; but when the workings extend below this point, a shaft is sunk to the lowest part of the mine, and the water is led into it and pumped up either to the adit-level or to the surface, where it is used for washing the ore. In some of the Cornish mines, the pumps work night and day, and an hour's stoppage would be sufficient to flood the mine. Much of the excavation is done by hand with the pickaxe, and *gad*, or iron wedge; but if the strata allow of it, large masses are removed at once by blasting with gunpowder. A hole, eighteen inches in depth, is bored into the rock, and about two ounces of powder are inserted; a slow-burning fuze is then carried from the powder to the mouth of the hole, and the whole is closed by ramming in clay. The ore, when it is brought to the surface, is dressed or sorted, an operation differing according to the value of the ore and its specific gravity. Taking copper, tin, or lead ores as types, the process pursued is as follows:—The ore is first sorted by hand, the purest portions being set aside ready for smelting. The rest is broken by hammers into pieces the size of a walnut, the best bits being again set aside. The remainder is then crushed, the finer portion being subjected to the operation of jigging, which consists in sifting the crushed ore in a stream of running water, which carries away the lighter portions. These, with the coarser pieces left from the crushers, are stamped and then *buddled*. A buddle is a wooden trough, from which flows a stream of water, spread out into a thin layer by a distributing-board. Below this, the crushed ore is placed, and the gentle stream flows over it, carrying away the lighter portions and leaving the heavier behind. It will be seen that the operations of jigging and buddling depend on the difference of specific gravity between the ore and its matrix. When the two assimilate, these processes cannot be resorted to. The dressed ore is then either smelted on the spot, or else carried to some other part of the country where fuel is abundant. The operations of mining in Great Britain are conducted on a scale unknown in other countries. The extraordinary variety of minerals we possess renders us not only independent in this respect; but, from the large amount of cheap fuel supplied by our coal-mines, we find it profitable to import ores for smelting from all parts of the world. Our coal, iron, salt, copper, tin, lead, and zinc mines, to say nothing of immense deposits of sandstone, chalk, limestone, granite, serpentine, &c., annually bring into the coffers of the nation no less than £32,000,000, an amount which is steadily increasing year by year by discoveries of new mines, and by improved methods of working.—*Ref.* Ure's *Dictionary of Arts, Manufactures, and Mines*; Budge's *Practical Miner's Guide*; *Atlas du Mineur*, Paris, 1837; Karten's *System der Metallurgie*, Berlin, 1830; Taylor's *Mining Records*; the *Mining Review*, Dunn's *Winning and Working of Coal-mines*. (*See* MINE.)

MINION, *min'-yon* (Fr. *mignon*), is an insignificant or low dependent, a favourite on whom benefits are undeservedly lavished. Minion is also the name given to a certain kind of type, intermediate in size between nonpareil and brevier; thus, a, b, c. Why it received this name is unknown; "probably," says Johnson, "it was held in great estimation on its first introduction, and consequently received the title of *minion* (darling)."

MINISTER, *min'-is-ter* (Lat.), is properly a servant, or one who acts under another. In Pol., it is one to whom a sovereign intrusts the direction of affairs of state. In this country, the term ministry is used as a collective noun for the heads of departments in the state, but the individual members are not so designated. The ministry is, in fact, a committee of the leading members of the two houses. It is nominated by the crown, but consists exclusively of statesmen whose opinions on the pressing questions of the time agree in the main with those of the majority of the House of Commons. Some eminent party leader, who has the confidence of the House of Commons, is authorized by the sovereign to form a ministry, the members of which he selects from his party, or from those favourable to his policy, he himself being the prime minister, and taking commonly the office of first lord of the Treasury. Those of the ministers who are peers sit in the House of Lords, the others sit in the House of Commons, in virtue of being elected members, which is indispensable. When the House of Commons, by a decisive vote on a test question, shows that it no longer approves of the policy of the cabinet, the ministers are expected to resign and make way for a new cabinet. (*See* CABINET.) A foreign minister is one who represents his sovereign at a foreign court. (*See* DIPLOMACY, AMBASSADOR.) Minister, in religion, is applied to a pastor of a church, chapel, or meeting-house.

MINIUM, *min'-i-um* (Lat.).—Red-lead was formerly called minium: it is a compound of the protoxide and peroxide of the metal.

MINNESINGERS, *min'-ne-sing'-erz* (Ger. *Minne*, love; and *Sanger*, singers), were a school of German poets which sprang into existence in the latter half of the 12th century, and flourished until near the close of the 13th. Their themes were amatory and heroic, and were treated in much the same style as those of the troubadours of Provence, though in a more earnest spirit. (*See* GERMAN LANGUAGE AND LITERATURE.)

MINNOW, *min'-no* (Fr. *menu*, small), (*Leuciscus phoxinus* of Cuvier), an abdominal malacopterygious fish, belonging to the fam. *Cyprinidæ*. It is variously termed the minnow, minim, or pink, and is one of the most prettily marked, as well as smallest, of the British Cyprinidæ. The top of the head and back are a dusky olive, mottled and lighter in colour on the sides; the under surface of the body is white and a fine rosy pink in summer; the irides and gill-covers silvery; dorsal fin pale brown; pectoral, ventral, and anal fins lighter in colour; the tail being brown, and of a lightish hue.—*Ref.* Yarrell's *British Fishes*.

MINOR, *mi'-nor* (Lat., less), in Law, is a person under age, one who, by the laws of the country, is not arrived at the power of administering his own affairs,

or the possession of his estate. Here a person is a minor till the age of twenty-one. (*See* INFANT.)

MINOR, in Mus., the opposite to *major*, a term used in music to distinguish the mode or key that takes a minor third, as well as to designate all the diatonic intervals, more especially the *third*, which comprises a tone and a semitone (A—C), while the major third consists of two whole tones (C—E).

MINSTREL, *min'-strel* (Fr. *menestral*), is a term introduced into this country by the Normans, and applied to a class of men who gained a livelihood by the arts of poetry and music, singing to the harp their own verses, or the popular ballads and metrical histories of the time. They sometimes accompanied their music with mimicry and action; so that they were often called *mimi, histriones, joculatores*. They were everywhere held in the highest estimation, being welcomed and caressed by all classes of society, and no great entertainment was considered complete which was not enlivened by their talents. From the Conquest downwards, for many ages in England, the profession [illegible] the minstrel was a popular and privileged one. [illegible] merous instances occur in the early history of Engla[illegible] showing the esteem in which they were held even [illegible] royalty itself, and they were often more amply paid than the clergy. "In the year 1441," says Warton, "eight priests were hired in Coventry to assist in celebrating a yearly obit in the church of the neighbouring priory of Maxtoke, as were six minstrels called *mimi*, belonging to the family of Lord Clinton, who lived in the adjoining castle of Maxtoke, to sing, harp, and play in the hall of the monastery during the extraordinary refection allowed to the monks on that anniversary Two shillings were given to the priests and four to the minstrels, and the latter are said to have supped *in camerâ pictâ*, or the painted chamber of the convent, with the sub-prior; on which occasion the chamberlain furnished eight massy tapers of wax." As learning and culture began to prevail, the high admiration in which this class of persons was held began to subside; poetry was cultivated more by men of letters, and the poet and minstrel became two distinct persons. So late as the reign of Henry VIII these reciters of verses found free access into all companies, the mansion of the noble as well as the village tavern. But they were gradually sinking int[illegible] contempt; and in the reign of Elizabeth so singul[illegible] phenomenon had a veritable minstrel become, that when one of these ancient singers made his appearance at Kenilworth Castle, in 1575, before the queen, he excited so much interest that old Laneham has given a minute description of his person and dress in his "Princely Pleasures of Kenilworth." Towards the end of the 16th century this class of persons had lost all credit, and by an act passed in the thirty-ninth year of Elizabeth they are classed with rogues, vagabonds, and sturdy beggars, and adjudged to be punished as such. In the present day [illegible] a musician, a player upon some [illegible] Warton's *History of English Poetry*, [illegible] *phia Literaria Britannica*.

MINT, *mint* (Ang.-Sax. *mynet*, money or coin), name given to the place where the national money [illegible] coined. There is no accurate account of the manner in which coins were manufactured in this country at an early period; but it is generally supposed, from a passage in Cæsar, that the value of pieces of metal was determined only by their weight. It would appear, however, that the Britons, at the time of the Roman conquest, had brass and silver coins, In the Anglo-Saxon and early Anglo-Norman mints, the coins were made by the moneyers, who were the principal officers in those establishments. An officer called the reeve seems to have had some connection with the mint, or some authority over it. All the officers of the mint, after the Norman conquest, appear to have been placed, in some degree, under the authority of the court of Exchequer, as they assumed their respective stations and took the oath of office before the treasurer and barons of that court. During this period there were many mints beside the king's, and some of these remained in existence till a much later date. Money was struck by barons and bishops, especially in King Stephen's reign, and in some instances, the privilege of coining was granted to the larger monasteries. The moneyers of the Mint seem to have enjoyed important and exclusive privileges from a very early period. From the time of the second Henry, they seem to have been exempted from the payment of taxes. Although this seemed to be understood by all parties, it was not till the reign of Edward I. that these privileges were granted by charter. They were extended and added to by Edward III., Richard II, Edward IV., Henry VII., Henry VIII., Edward VI., and Philip & Mary. In the first year of Elizabeth's reign important privileges were secured to the workers of the Mint, many of which were enjoyed to a recent period; but all of which are now abolished. In 1799, under George III., the salary of the master and worker of the Royal Mint was fixed at £3,000 a year, in lieu of all fees, perquisites, &c.; and in 1837, under William IV., this sum was reduced to £2,000. A government commission was at length appointed in 1848 to investigate the system of worki[illegible] at the Mint, and to report thereon. The result of t[illegible] inquiry was a statement that the system was extremely complicated, and that the refiner, smelter, and moneyers received excessively large profits from their offices. These persons considered themselves a close corporate body with vested rights; and it was with great difficulty that the commissioners could obtain any information from them with regard to their profits or receipts. When Mr. Shiel was master of the Mint, in 1850, the government requested him to draw up a plan of reform based on a report of the commissioners. This he did; and upon his being appointed to the embassy at Florence, Sir John Herschel, as a [illegible]man of science, instead of a mere political adherent, [illegible]became master of the Mint. All the officials of the Mint are now paid regular salaries; the old plan of retaining fees or perquisites being abolished. By a certain agreement, moreover, all the gold and silver at [illegible] Mint is refined, between a fixed [illegible] minimum and [illegible] mum, at the price of four shillings per pound for gold, and sixpence per pound for silver. Although [illegible]he Mint, as it stands at the present day, is bound by [illegible]aw to convert into coin, at the public expense, any gold bullion that may be brought to it for that purpose, [illegible] quite, or of nearly standard fineness; nevertheless, the Bank of England is practically the only real customer which the Mint has. This results from [illegible] in monetary matters which that great [illegible] possesses. In exchange for the bullion [illegible]eceived, the Mint transmits gold coins to the Bank of England In the case of silver, copper, and bronze coin, the method is different, the officers of the Mint purchase the metals required, convert them into coins, and exchange them for gold or notes to any purchaser. The Mint itself is divided into several distinct departments.—the Mint office where the bullion or coin is delivered and stored; the assay department; the melting establishment, for converting the bullion into [illegible] proper value; the coining establishment, [illegible] the bars into medals or coins; the die [illegible] for [illegible] the dies or engraved devices to impress [illegible], and the machinery department. In early times, the method of coinage was very rude and simple. One die was fixed firmly in a wooden block, while the other one was held in the hand as a punch, by striking the latter repeatedly with a hammer, the design was at length worked up. This inartificial mode of coining appears to have been in use till the 16th century, when the screw was applied to coinage in the French mint. When ingots of gold arrive at the Mint, they are carefully weighed and assayed, in order to ascertain their value; they are then passed to the melting-room, where they are again weighed, and the melter gives a receipt for them. Each ingot is valued at about £800. During the melting, a certain amount of alloy is added, to bring the gold to the standard value. The melted gold is then run into cast iron moulds, and when cooled is taken out in bars about 21 inches long, 1¼ inches wide, and 1 inch thick, if for sovereigns, and somewhat longer and narrower for half-sovereigns. The processes of weighing, assaying, melting, and running into bars, of silver, are almost identical with those for gold, only requiring larger apparatus, on account of the greater weight of metal employed. On being removed from the moulds, the bars are transferred to the

rolling-mill, through which they are passed over and over again till they attain a length of seven or eight feet: they are cut into five pieces each, annealed in a furnace, then rolled again, until brought down to a thickness slightly greater than that of the different kinds of coin. These operations are almost the same for silver and copper coins as for gold. After being flattened and rendered uniform, the fillets of gold are cut out into blanks by means of twelve powerful presses arranged in a circle. These machines are fed by boys; and so rapidly can the work be effected, that the twelve presses can cut 200,000 sovereign blanks in a day. The waste cuttings are sent back to the melting-house. The blanks are then weighed in delicate and ingenious weighing machines, invented in 1855 by Captain (afterwards Col.) Harness, then deputy-master. The blanks are fed into each machine through a spout, and pass singly on to a delicate balance. If correct in weight to the tenth of a grain, it passes at once into the "correct" box; but if it is "heavy" or "light," it passes into receptacles prepared for each respectively. An average of between ninety-eight and ninety-nine blanks out of 100 falls into the "correct" box. The blanks are then passed to the marking-machines, eight in number, where their peripheries are made perfectly circular. After this, they are heated for a few minutes to a cherry-red heat, cooled in water, pickled or blanched in dilute sulphuric acid, dried with heated beech-wood sawdust, and made up into bags of definite weight. A bag of sovereign blanks contains about 700 pieces, and weighs about fifteen pounds. The next process is the coining or stamping. For this purpose there are eight powerful and massive presses. The blanks pass singly on to the lower die, which is supported by an anvil; the upper die is then brought down upon the blank with a combination of screw power and pneumatic power, and a sovereign stamped on both sides and milled on the edge drops out. A similar process, differing somewhat in details, is employed in the manufacture of other coins. The average amount of coinage during the last twenty years has been somewhat above £5,000,000 per annum. Besides the Royal Mint on Tower Hill, in which Professor Graham is the master and Professor Brande superintendent of the die department, there are several colonial mints. In Canada the decimal system has been adopted in the mint. The Calcutta mint is of great magnitude; and there are also large mints at Madras and Bombay. In 1854, a mint was established in New South Wales, the colonists transmitting £10,000, being the cost for buildings and machinery; and in a year and a half about 450,000 ounces of gold were coined into sovereigns and half-sovereigns. Since that time more powerful machines have been sent out.

MINT. (*See* MENTHA.)

MINUET, *min-u-et'* (Sp. *minueto*), a slow graceful dance, consisting of a *coupée*, a high step and a balance, supposed to have been originated in Poitou about the middle of the 17th century. A movement of three crotchets or three quavers in a bar is also called a minuet.

MINUTE, *min'-ute* (Lat. *minutum*), the sixtieth part of an hour of time, or the sixtieth part of a degree of a circle. Minutes of time are generally denoted in astronomical works by the letter *m*, and minutes of space by the dash or acute accent, which was first introduced by Pliny. Every minute (1′) is also divided into sixty equal parts, each called a *second* (1″).

MIRABILIS, *mi-rab'-i-lis* (Lat., wonderful), in Bot., the Marvel of Peru, a gen. of the nat. ord. *Nyctaginaceæ*. The species form highly ornamental border plants. The roots of *M. jalapa* and *longiflora* have purgative properties; those of the first-named species were long erroneously supposed to constitute our medicinal *jalap*. *M. dichotoma* is commonly called the four-o'clock plant, on account of its opening its flowers in the afternoon.

MIRACLE, *mir'-ă-kl* (Lat. *miraculum*, from *miror*, I wonder), may be defined to be a sensible deviation from the known laws of nature, by an act of the Supreme Being, or such a control of natural causes as bespeaks the intervention of a cause to which they are secondary. Hume defines it to be a transgression of a law of nature by a particular volition of the Deity, or by the interposition of some invisible agent. A miracle, then, has a supernatural origin; it supposes a contrast between the natural and supernatural, and manifests itself in such a way as to be subject to the scrutiny of the senses, and an object of human testimony. The true notion of a miracle is that it is inconsistent with and cannot take place by virtue of the laws of nature. If the raising of Lazarus from the dead took place agreeably to some law of nature, though unknown to us, such is inconsistent with our idea of a miracle. Hence, we cannot accept the definition of Spinoza, that "a miracle signifies any work the natural cause of which we cannot explain after the example of anything else to which we are accustomed; or, at least, he who writes about or relates the miracle cannot explain it." The miraculous, however, consists in being not *contra*-natural, but *extra*-natural; for, as Augustine says, "How is that against nature which comes from the will of God, since the will of such a great Creator is what makes the nature of everything? In miracles, God does nothing against nature; what is unaccustomed may appear to us to be against nature, but not so to God who constituted nature." The objections that have been urged against miracles, have respect either to the abstract possibility of miracles, or the violation of the laws of nature supposed to be involved; or, again, to the possibility of their proof, allowing them to be possible in the abstract. The former of these objections may be said to have acquired strength from the increased knowledge of the laws and operations of nature in modern times; but if it be conceded—and this is a question belonging to the much more extensive field of natural theology—that there is a Supreme Being by whom all things were made, and who established the laws of nature, it cannot be supposed that he has not also the power of suspending them. To deny the possibility of miracles is to deny the existence of a Supreme Being. Hume, while admitting the abstract possibility of miraculous intervention, takes the ground that testimony, through which alone we know of miracles, is often fallacious, while constant experience is in favour of a uniformity of nature. "Miracles," he says, "are incredible, because they are contrary to experience." If he means by experience, the uniform experience of mankind, then he is merely begging the question; if he means their general experience, then his statement is true; but it is nothing to the purpose. Miracles are, from their very nature, of rare occurrence, and, being rare, are necessarily at variance with the general experience of mankind. If they were not, they would, as Paley remarks, be no miracles. It has also been urged that by the mode in which Hume makes use of his positions it would be impossible to prove many facts which are generally admitted, since there has been no experience reaching to such facts. The miracles recorded in Scripture were wrought to introduce a new dispensation, or to confirm its introduction. The writers who mention them were eye-witnesses of the facts, which they affirm to have been performed publicly in attestation of the truth of their doctrines. The two are, indeed, so incorporated together that the one cannot be separated from the other; and if the miracles be not really performed, the doctrines cannot possibly be true. The repetition of miracles in proof of any particular doctrine would have impaired their character and validity, and if allowed at all, would have been perpetually necessary. Our Lord and his apostles reprehend the desire to behold miracles beyond the limit of their first and chief design, as a disposition of unhallowed curiosity and presumption. "It appears to me," says Dr. Pye Smith, "the most probable supposition, that miracles ceased *gradually*, as those persons died who had received these gifts from the apostles. The miracles displayed in the writings of the fathers are often of a character puerile and unworthy, and are deficient in some of the marks of credibility."

MIRAGE, *me-rajhe'* (Fr.), a term applied to an optical phenomenon very common at sea, especially in high latitudes. It is sometimes also seen on land, especially in Egypt and Persia. The name of "looming" has long been applied at sea to the elevation or apparent bringing near of coasts, mountains, ships, &c.; and when the same phenomenon is accompanied

by inversion, it is termed a *mirage*. The appearance presented is very singular, being that of a double image of the object in the air,—one of the images being in its natural position, and the other inverted, so as to give the appearance of a distinct reflection in the water. The mirage is produced when the rays of light are unequally refracted in the lower strata of the atmosphere. The surface of the earth or sea becomes heated, and transmits a portion of its heat to the layer of air lying directly above it, which thus becomes less dense than the superincumbent layers. When rays of light pass from an object in the heated layer, they are bent downward, and thus arrive at the end in such a direction as to make the object appear elevated above its true position. Thus, in the desert, where the surface is level, the mirage takes the form of a lake, deceiving the thirsty traveller with an appearance of cool water and green trees, which vanishes as he approaches nearer, and changes the angle of vision. In the whale-fishery, ships are often seen, and sometimes recognized, at considerable distances by means of the mirage: Captain Scoresby thus recognized his father's ship at [illegible] miles. In the "Mémoires des Instituts" for 18[illegible], the mathematical theory of the phenomenon of the mirage is elucidated by M. Biot.

MIRROR, *mir'-ror* (Fr. *miroir*), any glass, metal, or polished substance that forms images by the reflection of light. In ancient times mirrors were made of metal, but at the present day they are usually smooth plates of glass, tinned or silvered on the back, and are either plane, convex, or concave. A *plane* mirror, or looking-glass, reflects the rays in a direction similar to that in which they fall on it; hence objects are represented of their natural size, by it. In a *convex* mirror, the rays are made to diverge, and the images of objects seen in it are consequently diminished; while, in a *concave* mirror, the rays are collected into a focus, and then, at a certain distance, images are seen inverted and magnified. A concave mirror also acts in the same manner as a burning-glass when exposed to the rays of the sun and the body to be ignited is placed in the focus. In scientific language, the mirror, whether made of glass or metal, is generally called a speculum. The astronomical value of any speculum is dependent on the quantity of light that it can concentrate, and on the precision with which it forms the optical image of a distant object; for which reasons the magnitude, the curvature, and the surface polish, are all of importance. Speculum metal is an alloy of tin and copper. The alloy used by Newton in the first reflecting telescope consisted of 120·4 parts of copper to 58·9 of tin, or 32 to 15 nearly. It is very brilliant, but very brittle, and so hard and friable that it cannot be worked with steel tools. The six-feet speculum of Lord R[illegible] telescope weighs four tons. The processes of casting, grinding, and polishing these large mirrors are very difficult. Silver is sometimes used instead of speculum metal in making astronomical specula; the former reflects more incident light than the latter, but is liable to tarnish.—*Ref.* article Speculum in Nichol's *Cyclopædia of the Physical Sciences*.

MISADVENTURE, *mis-ăd-ven'-ture* (Fr. *mésaventure*), denotes mischance or misfortune; somet[illegible] hap[illegible]ing amiss.—In Law, homicide by misadvent[illegible] a man, doing a lawful act, without any intention of hurt, unfortunately kills another; as where a man is at work with a hatchet, and the head thereof flies off and kills a bystander, or where a person is shooting at a mark and undesignedly kills a man. The homicide, in such cases, is excusable. (*See* HOMICIDE.)

MISANTHROPY, *mis-ăn'-thro-pe* (Gr. *misos*, hatred; and *anthropos*, a man), denotes a general dislike or aversion to man or mankind. It is thus opposed to philanthropy, or a general love of mankind.

MISCELLANY, *mis-sel'-lă-ne* (Lat. *misceo*, I mix), is a mixture or medley of things of various kinds or sorts. In Lit. it is applied to a collection of works, or treatises of various kinds; as Constable's *Miscellany*, Chambers's *Miscellany*.

MISDEMEANOUR, *mis-de-mean'-or* (Ang.-Nor.), in Law, a term applied to all crimes and offences, whether of omission or commission, less than felony. Misdemeanours are of two kinds,—either those which exist at common law,—*mala in se*, or those created by statute. The former class includes whatever mischievously affects the person or property of another, openly outrages decency, disturbs public order, is injurious to the public morals, or a corrupt breach of official duty. Misdemeanours created by statute are of two kinds; viz., those that consist in the omission or commission of an act enjoined or forbidden by statute, but not specially made the subject of indictment, and hence punishable at common law, it being a common-law offence to disobey a statute; and in those offences which are by statute made especially indictable, if the punishment is expressly defined, the provision of the statute must be strictly followed; but if the statute merely attaches a new penalty to what was already an offence at common law, the remedy may be pursued either as at common law or under the statute. The ordinary punishment of a misdemeanour at common law is by fine or imprisonment (short of imprisonment for life), or by both fine and imprisonment, at the discretion of the court. By several statutes special modes of punishment are provided for particular offences.

MISERERE, *mis-e-re'-re* (Lat., have mercy), is in general applied to any sacred composition of a penitential character. More particularly in the Roman Catholic church, it denotes a celebrated [illegible] hymn formed from the fifty-first Psalm, [illegible] Vulgate, begins with the words "Miserere mei, Domine." It has been set to music by several great composers; but the most distinguished is that of Allegri, which is performed annually in the Sistine Chapel at Rome in Passion week.

MISERICORDIA, *mis-er-e kor'-de-ă* (Lat., mercy), in Law, is an arbitrary amercement or punishment imposed on any person for an offence.—*Miséricorde* (Fr.) was also the name of a dagger used by the knights in the middle ages; so called, according to some, because used to put persons out of pain who were mortally wounded, according to others, [illegible] caused the vanquished to cry for mercy.—*Misericordias Domini* is the name given to the second Sunday after Easter, because the mass on that day begins with these words.

MISJOINDER, *mis-join'-der*, in Law, is the joining parties in a suit or action that ought not to be so joined. In equity, if the plaintiffs be misjoined, all the defendants may demur; if the defendants are misjoined, only those can demur who are improperly joined.

MISNOMER, *mis-no'-mer* (old Fr. *mes*, wrong; *nommer*, to name), in Law, is a wrong name, or the using of one name for another. In real and mixed actions at common law, a misnomer is a ground for abatement, but in personal actions no plea for abatement in a misnomer is allowed. Misnomers in proceedings are now frequently amended by the court, provided the other parties have not been misled nor prejudiced by them.

MISPRISION, *mis-priz'-zhun* (Fr. *mépris*, a neglect or contempt), in Law, is generally understood to apply to all such high offences as are under the degree of capital, but closely bordering thereon; and it is said that a misprision is contained in every treason and felony whatsoever, and that if the crown so please, the offender may be proceeded against for the misprision [illegible] two sorts,—negative, [illegible] which ought to be revealed; and positive, the commission of something which ought not to be done. The latter, however, are now commonly described as contempts or high misdemeanours. Misprision of treason is the bare knowledge and concealment of treason, without any degree of assent thereto; for any assent makes the party a principal. Misprision of felony is the mere [illegible] in a public officer is punishable [illegible], with imprisonment for a year and a day, and in a common person imprisonment for a less but discretionary time; and in both, fine and ransom at the king's pleasure. Positive misprisions, contempts, or high misdemeanours, are such as the mal-administration of such high officers as are in public trust and employment, usually punishable by parliamentary impeachment; embezzlement of the public money, punishable by fine and imprisonment; and such contempts of the executive magistrate as demonstrate themselves by some arrogant and undutiful behaviour towards the sovereign and govern-

ment. The term misprision is also applied to mistakes arising from negligence or carelessness, as in writing or keeping records, or what are commonly termed clerical errors.

Missal, *mis'-sāl* (Lat. *missale*), in the Roman Catholic church, is a book containing the services of the mass for the various days of the year. In the ancient church, the several parts of divine service were arranged in distinct books; as the *Sacramentarium*, containing the collects and the invariable portion of the communion service; *Lectionarium*, the lessons from the Old and New Testaments; *Evangelisterium*, sections from the four gospels. About the 11th or 12th century, it was found convenient generally to unite these books, and the combined volume was called the complete or plenary missal. Considerable deviations and corruptions having crept into the missal, the council of Trent recommended its revision, which was commenced under Pius IV., and published under Pius V., in 1570. New revisions were made under Clement VIII. and Urbán VIII. The missal consists of three principal parts, viz., 1. the *Proprium Missarum de Tempore*, containing the formularies of the masses for the Sundays; 2. the *Proprium Missarum de Sanctis*, containing special formularies of mass for the festivals of a number of saints; 3. the *Commune Sanctorum*, containing general formularies for classes of saints (as apostles, martyrs, confessors, &c.), serving as an appendix to the second part for such saints as have no special service assigned them. (*See* Mass.)

Mission, *mis'-shun* (Lat. *missio*; from *mitto*, I send), in a theological sense, denotes the efforts made by the professors of a religious creed to propagate their doctrines in foreign countries. In the traditions of many barbarous nations, there is a floating recollection of a change effected in their religious opinions and worship at the suggestion of teachers from some other clime. The advances of the Brahmins over India, and the progress of the Buddhists in disseminating a foreign creed as far as Japan and Central Asia, are evidences of a missionary spirit. Judaism, unlike other forms of worship, did not strive to make converts. Missionary effort is, however, more closely connected with Christianity than with any other creed. "Go ye," said Christ to his disciples, "into all the world, and preach the gospel to every creature;" and, in compliance with this command, the apostolic church began a series of missionary labours, such as the world had never seen before. Towards the close of the 1st century, flourishing churches had been established in the towns of Asia Minor, Greece, Italy, the islands of the Mediterranean, Northern Africa, and probably several other countries. In the 2nd and 3rd centuries, we find missionaries labouring successfully in southern Germany, Gaul, Arabia, and Ethiopia. Under Constantine, Christianity became the state church, and the custom was gradually introduced of using coercive measures for the advancement of the Christian doctrines. The popes do not seem to have done much for the diffusion of Christianity by missionary effort. Their attention was generally too much occupied with the dissensions of nominal Christendom, and the opportunities of increasing their power at the expense of the secular powers. Individual effort, however, was not wanting to carry on the work, and through the labours of St. Patrick in Ireland and St. Columba in Scotland, these two countries became celebrated nurseries of missionary enterprise. Gallus, the apostle of Switzerland; Boniface, the apostle of the Germans; Anochar, the apostle of the North; and Frumentius, the apostle of the Ethiopians, were also distinguished. A new missionary zeal awoke in the Church after the foundation of the mendicant orders, each striving to excel the others in extending the territory of the Church. The discovery of America in 1492, and the circumnavigation of the Cape of Good Hope in 1497, opened up new and extensive fields for missionary labour. An extraordinary impulse was given by the establishment of the order of Jesuits, all the members of which were under a vow to go as missionaries wherever it might please the pope to send them. Among these, none distinguished himself more for his missionary zeal and labours than Francis Xavier, the apostle of the Indies and Japan. In every accessible country—in India, China, Japan, Morocco, Abyssinia, Madagascar, Mexico, Chili, Peru—missionaries were to be found. In 1622 the pope instituted a congregation of cardinals *de propagandâ fide*, and a few years later, a college was established for the propagation of the faith. During the early part of their existence, the Protestant churches did not engage largely in missionary labour, probably partly on account of the unsettled state of their affairs at home; but we believe, to some extent also, from a feeling of opposition to whatever seemed to savour of the Church of Rome. Even so late as the end of the last century, and in the General Assembly of the Church of Scotland, there were persons who spoke against missionary societies as being dangerous in their tendency to the good order of society, and eulogized the innocence of savage life as not requiring a gospel. The earliest attempt made by Protestants was the sending of fourteen Swiss missionaries to Brazil, in 1556. Gustavus Vasa, of Sweden, and a number of the German princes, endeavoured to awaken an interest in the missionary cause, but with little success. In 1621 the Dutch opened a church in the city of Batavia, and from thence ministers were sent to Amboyna. At Leyden missionaries were educated under the celebrated Walaeus, and sent into the East, where thousands embraced Christianity. The settlement of New England by a company of nonconformists was soon followed by the arrival of John Eliot, who laboured among the North-American Indians, having as his colleagues John Cotton, the Mayhews, and others. Cromwell conceived the idea of uniting all the Protestant churches of the world into one great society for the propagation of the gospel in foreign parts; but though the scheme was not carried out, it turned the attention of England to the importance of missionary labour. In 1701, the "Society for the Propagation of the Gospel in Foreign parts" was established under the sanction of William III. About 1705, Frederick of Denmark applied to the university of Halle for missionaries to preach the gospel on the coast of Malabar, and Messrs. Ziegenbalg and Plutcho were dispatched on this important mission. The Moravians have, however, exceeded all others since the apostolic times in their zeal for missionary enterprise. They selected people the most low and abandoned, countries the most difficult and miserable, as the scenes of their labours: the Hottentots of Southern Africa; the Arrowack Indians, and the negroes of Surinam and Berbice; and the inhospitable regions of Greenland and Labrador. The missionaries supported themselves by mechanical or agricultural labour, and the converts were organized after the model of the church at home. (*See* Bohemian Brethren.) The Methodists have also done much good in the missionary field. The "Baptist Missionary Society" founded in 1792, and has laboured more particularly in the East and West Indies, and Western Africa. In 1795, the "London Missionary Society" was formed, consisting of Episcopalians, Presbyterians, and Independents. The islands of the Pacific were selected as the first missionary field, and twenty-nine young men, selected from a large number that had offered themselves, were sent out. Its principal stations are now in the South-Sea Islands, Southern Africa, India, China, British Guiana, Jamaica, Mauritius. The "Church Missionary Society" was founded in 1799, by a number of distinguished men belonging to the Evangelical school of the Established Church. The "Scottish Missionary Society" was organized at Edinburgh in 1796, and in 1824 the General Assembly of the Church of Scotland established their society. At the "disruption" of 1843, the Free Church also established [illegible] nary society. It is reckoned that about £600,000 is annually expended by the various Protestant churches on missions among the heathen; of which nearly two-thirds is expended by British societies, about £50,000 by continental, and £160,000 by American. For a time Roman Catholic enterprise languished; but since 1814 it has been carried on with renewed zeal, and the number of missionaries greatly increased, without, however, any extraordinary marks of success. —*Ref.* Dr. Brown's *History of the Propagation of Christianity among the Heathen*, 3 vols. 1854; Newcomb's *Cyclopædia of Missions*, 1860; Aikman's *Cyclopædia of Christian Missions*, 1860; and the *Reports* of the various societies.

Plate LXXXV.—MITRAILLEUR.

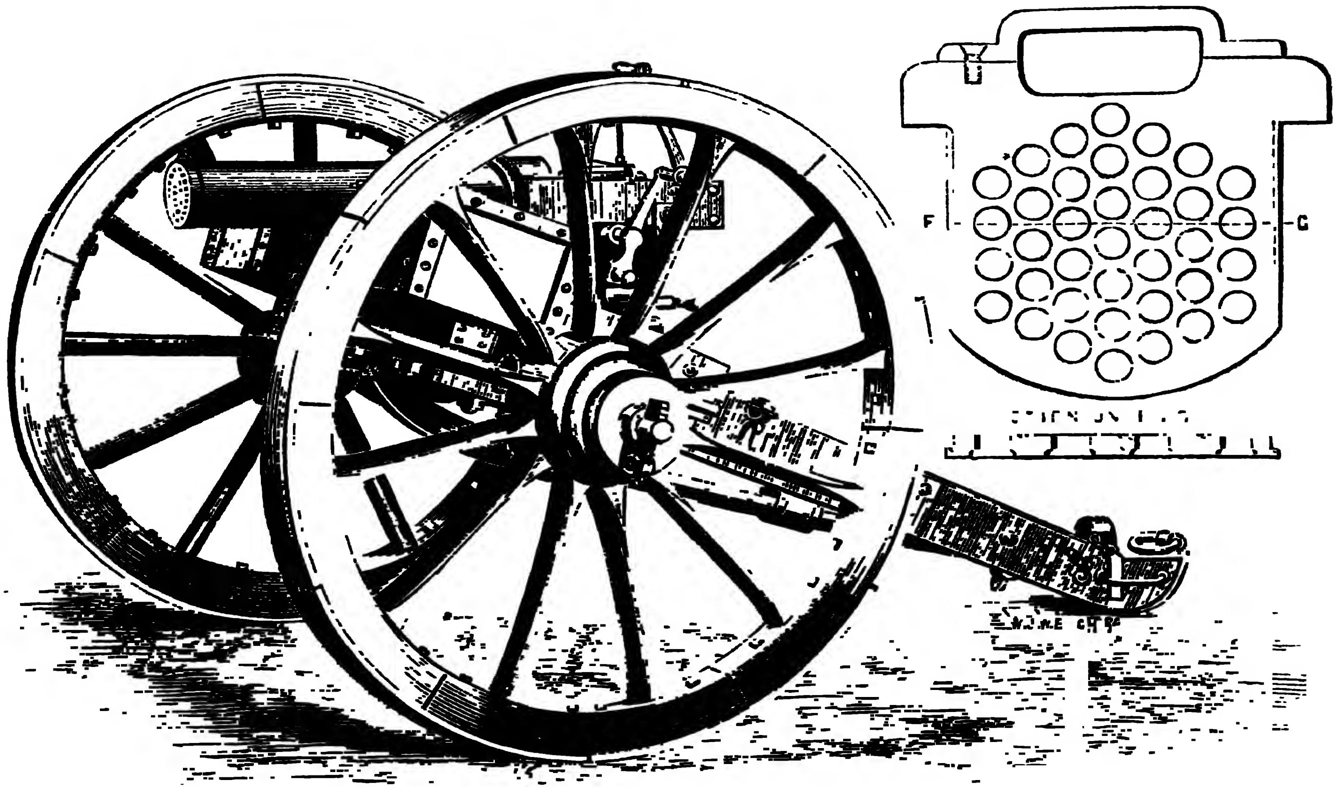
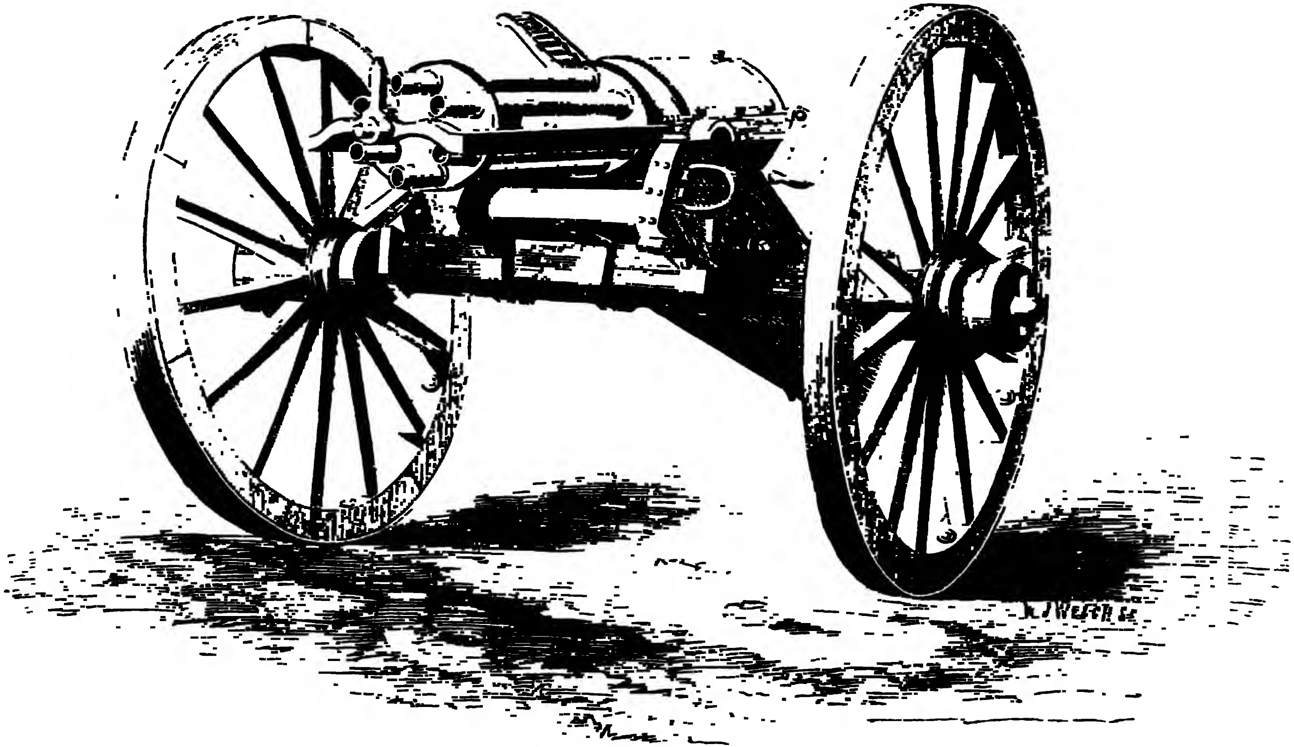


Plate LXXXVI.—MITRAILLEUR: THE GATLING GUN.



MIST, *mist* (Sax.), the vapour of water rendered visible by the lowering of the temperature of the atmosphere. At ordinary temperatures, at all times, w—— is rising into the air in the state of vapour; and when the air is of the same or a higher state of temperature, it is invisible. The sole cause of the evaporation of water is heat; the amount of vapour produced is consequently in proportion to the temperature; and it therefore follows that there is more water-vapour in the air in summer than in winter, and in hot countries than in temperate climates. As the quantity of vapour which the atmosphere will contain at any given temperature is limited, whenever that quantity approaches the point of saturation, a slight reduction in temperature produces *mist*, while a further reduction converts the vapour into rain. When the mist is very dense, it is generally called a *fog*. The London fogs are produced in winter by the condensation by cold of the large quantity of vapour produced by a great city. This condensed vapour is also mixed with smoke, which renders it heavier, and causes it to hang over the valley of the Thames about London. When the vapours in the upper portions of the atmosphere are condensed, and become visible, they are called *clouds*.

MISTAKE, *mis-taik'* (Ang.-Sax.), is an error or misconception, an unintentional act or omission, arising from ignorance or imposture. The law carefully distinguishes between mistakes of law and mistakes of fact. As regards the former, it is an ancient and well-known maxim, *ignorantia legis neminem excusat* (ignorance of the law excuses no one). To this rule, however, there are some important qualifications; thus, if a person ignorant of a settled principle of law is induced to give up a right or a portion of his indisputable property, equity will step in and protect him. In general, too, equity will grant relief against an act done under a mistake or ignorance of a material fact, *i.e.* a fact essential to the character of the act. Obvious mistakes in a will or other deed will be rectified or supplied in equity when they are apparent on its face, or may be made out on a due construction of its terms. In criminal cases, a mistake of fact is an excuse; as where a man intending to do a lawful act, does one which not lawful; but it must be an ignorance or mistake of fact, and not an error in point of law.

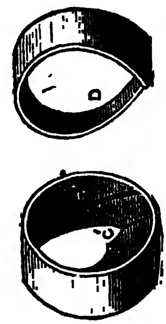
MISTLETOE, in Bot. (*See* VISCUM.)

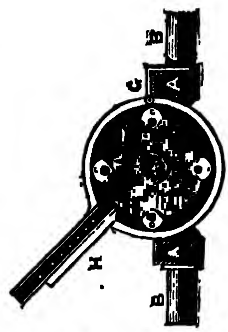
MITE. (*See* ACARUS.)

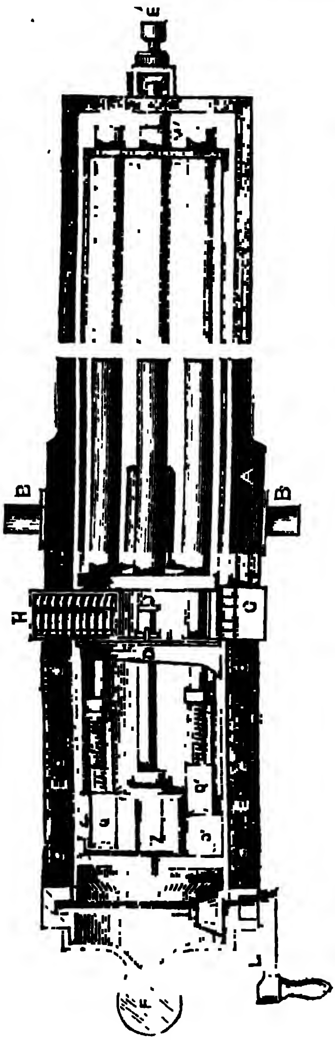
MITE, *mite* (Ang.-Sax.), is the name of a small coin that once was current, equal to about one-third of a farthing. The moneyers also use a small weight bearing the same name, and equal to the twentieth part of a grain, and divided into twenty-four doits.

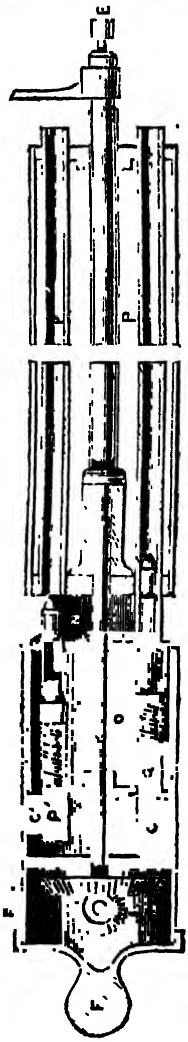
MITRAILLEUR, or MITRAILLEUSE, *mit-rall-yeur', mit-rail-yeuze'*.—Through the courtesy of the proprietors of that excellent paper, the *Engineer*, we are enabled to present drawings of the mitrailleur and the Gatling gun. From the pages of the same journal we borrow a description of both weapons. It is unnecessary to dwell upon the origin of the mitrailleur. It is simply one of that numerous family of deadly engines which man's desire to destroy man has given birth to. The invention, indeed, cannot be said to be new, as multiple-guns have been proposed and constructed for many years; practically, however, it slumbered until the French Emperor hit upon the idea of adopting a mysterious weapon, concerning which little was known, and which he fondly hoped would give a moral, even if it failed to give a material effect to his arms. Sadowa had been lost and won—the Emperor had marked the tremendous effect produced by the needle-gun, and he may have looked forward to a like triumph with the new engine. Like the needle-gun, it was an engine for multiplying deaths. It was designed to discharge a vast number of rifle bullets with great rapidity and accuracy. For this purpose machinery was brought into play; a number of rifles were bound together, and fitted with a common breech action, so that they could be loaded and discharged simultaneously. The genus mitrailleur has several species. We have the one-barrelled many-chambered weapon, fitted with a hopper, into which the cartridges are placed, and by which the barrel is fed. We have again the American or Gatling type, in which several revolving barrels are fed by a constantly supplying apparatus. Lastly, we have the Belgian pattern. The Christophe-Montigny mitrailleur was introduced into this country by Major George Fosbery, V.C., of the Bengal Staff Corps, by whom it was considerably improved. The details of the machine are as follows:—Number of barrels, 37; calibre, 0·534 in.; rifling, Metford's; grooves, five; depth, 0·011 in.; width, 0·234 in.; twist, one turn in 24 in.; nature of projectile, Metford's hardened expand... ...ght of projectile, 600 grains; cartridge, central-fire Fusnôt; charge, 115 grains of rifle F.G.; weight of arm, 400 lb. This gun has been temporarily mounted on an old 6-pounder gun-carriage fitted with special axletree-boxes to suit the ammunition. The limber-boxes are similarly fitted. The gun is formed of thirty-seven steel barrels, planed exteriorly to an hexagonal form, fitted and soldered together and to the wrought-iron tube which surrounds them. This forms the barrel of the weapon. To this tube or barrel is screwed a breech attachment, and the two together, with the movable breech-block and its lever, form the gun. In outward appearance the gun looks like a solid steel block about 4 ft. long, pierced with thirty-seven holes. The breech-block, containing the arrangement for igniting a central-fire cartridge in each barrel, slides backwards and forwards on two vertical broad plates in rear of the breech of the gun. It is moved to and fro to open and close the breech by a lever, and when in firing position it closes the whole of the barrels in rear. The long arm of the breech-block lever forms the handle by which it is worked, and the short arm is linked to the block. When the handle is raised, the block is drawn back by the link; when the handle is depressed, the breech-block is forced against the rear ends of the barrels and the lock springs cocked. The interior arrangements of the breech-block comprise thirty-seven lock springs, each something similar to that of the Snider rifle, thirty-seven pistons or plungers, and thirty-seven small steel strikers, all corresponding to the thirty-seven barrels in the gun. The ends of the strikers can protrude from small holes in the face of the breech-block. The cartridge-holder consists of the steel plate, shown on Plate LXXXV., in which are bored holes corresponding in position with the strikers and barrels in the gun, and formed so as to fit accurately the heads of the cartridge; it is about half an inch in thickness, and the holes, as shown in the engraving, are recessed, so as to receive the heads of the central-fire cartridges. The cartridges are carried in boxes, corresponding in size to the cartridge-holder, and when it is required to fill the latter, it is simply placed over the mouth of a box and the latter reversed; the cartridges then drop into their corresponding holes, and, when the holder is held up by the handle, stand out at right angles. To load the gun the lever is raised, thus drawing back the breech-block and uncocking all the springs. A plate filled with cartridges is then dropped into a groove on the face of the breech-block. The lever is then depressed, the breech-block moves forward, the cartridges enter the corresponding barrels, the plate comes in contact with the breech, the block is "home," and by a final movement all the springs are simultaneously compressed. The weapon is now charged with thirty-seven cartridges, and placed on full cock. The firing handle is on the right of the gun; as it is raised, the springs one by one are released, the plungers fly forward, come in contact with the strikers, and so fire the central-fire cartridges. The rapidity of fire depends upon the movement of the firing handle. The thirty-seven cartridges may be fired as independent shots, or the firing can be arrested at any point. On the other hand, the whole thirty-seven may be fired in a volley by a rapid upward movement of the handle. It is stated by Major Fosbery that ten discharges per minute may be easily maintained from the gun when worked by two men. It is evident, however, from the practice at Shoeburyness, that this is an over-estimate, and assumes that no hitch of any kind will occur throughout the practice. The engraving on Plate LXXXV. shows the Montigny mitrailleur mounted on the 6-pounder gun-carriage. The thirty-seven barrels are shown at the muzzle of the arm. In the rear the gunner grasps with his left hand the long arm of the breech-block lever, which is withdrawn preparatory to loading. In his right hand he carries a cartridge-

holder. The firing handle may be seen on the right of the gun, and the sights by which the arm is laid, on the upper left of the breech-block, directly under the gunner's left hand. The Gatling gun is shown on Plate LXXXVI., and in the accompanying engravings. This weapon was seen for the first time in Europe at the exhibition of 1867. It is more complex than the Belgian weapon, and, as we have said, very different in construction. An inclined plane receives the cartridges, which, iron, fixed on a central axis. At the rear of these are two half-cylinders of iron, bolted together which serve to inclose and protect the mechanism. The whole is mounted on trunnions, and carried on an ordinary gun-carriage.









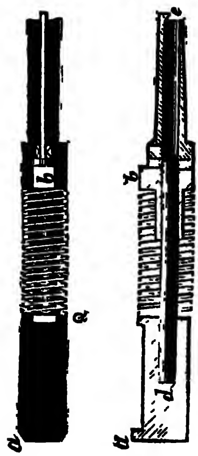


Fig. 2. Fig. 3. Fig. 4.

by turning the handle at the side of the breech, are introduced one after the other into the barrels and fired. It suffices to keep the inclined plane supplied with cartridges, and to turn the handle, to discharge a continuous shower of balls, never interrupted so long as these two operations are continued. The weapon consists of six rifled barrels mounted in two rings of Plate LXXXVI. is a view of the weapon complete; fig. 2 is an horizontal section; fig. 3 a vertical section; fig. 4 an elevation of the striker; fig 5 a section of the same; fig. 6 shows the method in which the cartridges are introduced; while fig. 7 shows the eccentrics which introduce and fire them. A, A is the frame in which the whole system is

mounted; E, E is the portion to which the semi-covering cylinders are fixed by bolts; B, B are the trunnions; H, the inclined plane down which the cartridges descend; N is a cylinder with grooves or hollows—see fig. 6—into which the cartridges drop; G is a half-cylinder movable on a hinge, into which the exhausted cartridges fall after extraction; P, P are the six rifled barrels, 1 in. bore; M, M are the discs in which these last are fixed; C, C[1] show in section the rings carrying the helical curves—see fig. 7,—which actuate the hammers, Q, Q[1], which produce the double effect of introducing the cartridges into the barrels and igniting them. D is another eccentric ring which enters the cartridges. L, the handle working the bevel wheels J. In fig. 3, I is the fore and I[1] the back sight. F is the cascable; K the axis round which the barrels rotate; O is the cylindrical case in which the mechanism is inclosed. The action of the mechanism is this: A cartridge is taken from the base of the inclined plane, pushed into the barrel, fired, and extracted. Fig. 4 shows the striking apparatus distinct. Fig. 6 is a piece which is first pushed forward, driving the cartridge into the barrel, and afterwards drawn back and suddenly released, by which the cartridge is ignited. To effect this the claw *a* is caught by the eccentric portion of the ring C, fig. 7, and receives from it a motion which carries it quickly forwards and backwards. Afterwards the claw *b* receives another movement from the ring D, fig. 7, which compresses and releases the spring, driving the needle into the cartridge and igniting it. The spiral spring keeps the claws *a* and *b* always home to the eccentric rings. *e* is a hook which, laying hold of the base of the cartridge, extracts it when empty. Fig. 6 shows a rear view of the distributing apparatus. H is the inclined plane with cartridges, which drop on the circumference of the disc N, which is made with cells, *n*, *n*. From these the cartridges are pushed into the bores of the barrels by the action of Q, Q[1]. Fig. 7 shows the two helices. The function of C is to push the cartridge into the barrels; of D to ignite them. The helical surface of the last first carries the needle to the rear, compressing the spring, and then leaves it suddenly free to strike. C and D are fixed inside O, fig. 1. It will be understood that the barrels rotate on K, each as it comes near the top being charged, subsequently discharged, and, the rotation being continued, emptied of its fired cartridge near the bottom. A thousand rounds have been fired continuously from the Gatling gun, which has not inaptly been named "a ball-pump." It is made in two sizes, one firing 100, the other 200 rounds per minute.—Ref. *The Engineer.*

Mitre, *mi'-tr* (Gr. *mitra*), is a sacerdotal ornament worn on the head by archbishops and bishops in the Roman Catholic and Greek churches, and also by abbots of certain orders. It consists of a stiff cleft cap rising in two points, one before and the other behind, and having two ribbon-like pendants, which fall upon the shoulders. The high priests among the Jews wore mitres; and we find similar head-ornaments among various nations of antiquity. Bacchus was often represented with a mitre; whence the Greeks styled him *Mitrophoros.* It is much disputed whether mitres were worn in the early ages of the Church.

Mittimus, *mit'-ti-mus* (Lat., we send), in Law, is a precept or command in writing addressed by competent judicial authority to a gaoler or keeper of a prison to receive into custody, and safely keep, the person charged with the offence therein named, until he be delivered by due course of law. It is also applied to a writ for removing and transferring records from one court to another.

Mixed Actions, in Law, are suits partaking of the nature of real and personal actions, real property being demanded, and also personal damages for a wrong sustained. They have now been abolished by 3 & 4 Will. IV., except the action of ejectment.

Mnemonics, or Mnemotechny, *ne-mon'-iks ne-mo-tek'-ne* (Gr. *mneme*, memory, and *techne*, art), is the art of improving the memory by artificial means. According to the account of the ancients, the discoverer of this art was Simonides the poet, who flourished about B.C. 500; the story being that during his temporary absence from a feast, the house in which they were assembled fell, killing all that were present, and mutilating their bodies so that they could not be recognized; but Simonides, recollecting the place that each had occupied at the feast, was able to distinguish them. His attention is said to have been thus directed to the important aid afforded to memory by the observation of material objects. This art was recommended by Cicero, Quintilian, and others of antiquity; but in modern times it does not seem to have met with that degree of general attention that its importance demands. This is, doubtless, mainly owing to the fact that its advocates have been chiefly desirous of exhibiting mere feats of memory, which Lord Bacon says that he esteems "no more than rope-dancing, antic postures, and feats of activity; and, indeed, they are nearly the same things,—the one being the abuse of the bodily as the other is of the mental powers; and though they may cause admiration, they cannot be highly esteemed." The value of any system of mnemonics must necessarily depend upon the extent to which it is based upon the principles and laws of memory. (*See* Memory.) Ideas recall or reproduce each other in the mind according to certain laws, known as the laws of association. (*See* Association of Ideas.) Some ideas are much more easily retained and recalled than others. The mind is first awakened to consciousness by sensations, and ideas connected with them are ever the most easy of retention and reproduction. Most persons may have observed how the sight of some particular object may recall a long train of ideas; as, for instance, the return to the scenes of one's childhood after a long absence will recall, in a most marked manner, long-faded ideas. Taking advantage of this principle, then, mnemonicians associate with some material object those ideas which they wish to remember. A person wishing to remember the heads or principal points of a discourse, would connect each of them in his mind with some object before him, so that the sight of the object would immediately recall the idea connected with it. In carrying out this principle, the system now generally adopted is to have a series of rooms, each so divided in the imagination as to present fifty places. Thus, in the first room, the front wall (*i.e.* that opposite the entrance) is divided into nine equal parts, or squares three in a row, for containing the units; the right-hand wall the tens, left the twenties, fourth wall the thirties, and the floor, similarly divided, the forties. The Nos. 10, 20, 30, and 40 are placed in the roof above the four walls, while 50 stands in the centre. Other rooms are divided in the same way to the number required. The learner has then to fix the different places accurately in his mind, so that on a number being given he may at once be able to recollect its place. When he has mastered this, he has then to associate each place with some familiar object; so that, on the object being suggested to his mind, its place may be recalled, or, when the place is before the mind, the object may spring up. Of course, any objects will do, provided they are familiar and easily recalled. Some may find it of advantage to classify them, as on one wall or room to have articles of dress, another articles of furniture, another birds; and so on. When these are thoroughly mastered, so that they may be run over in any order, then all that is necessary is to associate the ideas we wish to remember with the objects in the different places, so that, by thinking upon the objects, we will be able to recall the respective ideas in any order that may be required. In this way, some are able to repeat, after hearing only once, several hundred disconnected or unmeaning words—backwards, forwards, or in any other order. Next, as to the manner of connecting ideas together, so as to be able to recall them at will; [illegible], or recollecting, is merely the bringing [illegible] to those that were before it on a previous occasion. Ideas, or notions as they are sometimes termed, are of two kinds,—familiar and non-familiar. A familiar notion is one that has been frequently before the mind, and readily recalls a number of others. Thus a watch is a familiar notion, because, in thinking about it, a number of connected circumstances recur to the mind; but to many persons a Roman *As* would be a non-familiar idea, as they never heard of it before. In attempting to connect together in the mind two fami-

liar notions, the way is to compare them together and seek out some notion common to both. The effort of the mind in effecting this strengthens the attention, while the common notion serves infallibly to connect the one idea with the other. Thus, in connecting together the two ideas tallow and knowledge, we compare them and find that tallow enlightens, and so does knowledge. In order to avoid confusion and perplexity, one must take care to have no more than the two ideas before the mind at the same time. When we have to connect a familiar with a non-familiar notion, or two notions which present us nothing in common, then the non-familiar notion has to be converted into a familiar one, and the two then united; and in the same way, when both notions are non-familiar, they require to be converted into familiar ones. As a general rule, the more closely two ideas are brought together in the mind the more strongly will they be associated and the greater their power of reproducing one another. Hence, proximity is another principle available in mnemonics, it being said that "the rapidity and strength with which two given notions stick together [illegible] in the inverse ratio of their [illegible] the time that elapses between [illegible] upon the brain. It is upon this [illegible] is called the Hamiltonian system of teaching languages is constructed; that, namely, of bringing the foreign word and the English equivalent into the nearest possible proximity. "The rapidity and strength with which two given notions stick together is in the ratio of their joint familiarity." In remembering dates or sums, the way is to substitute letters for figures and form them into words, for the sake of euphony, the vowels being of no value. Thus, $t=1$; $n=2$; $m=3$; $r=4$; $l=5$; $d=6$; c, k, g, $q=7$; b, h, v, $w=8$; p, $f=9$; s, x, $z=0$. For the application of mnemonics to the various departments of learning, we must refer to some of the various books on the subject. An account of the most important works on mnemonics is to be found in Feinaigle's "New Art of Memory," 1813; or in Reventlow's "Lehrbuch der Mnemotechnik," 1843; and a good [illegible] of practical treatise is Major Beniowski's "Handbook of Phrenotypics," 1845.

Moat. (*See* Advanced Ditch.)

Mobilier, Crédit. (*See* Crédit Mobilier.)

Mocking-Bird, *mok'-ing* (Fr. *moquer*, to mock), a bird belonging to the dentirostral tribe, of the ord. *Passeres* and fam. *Turdidæ*. The mocking-bird is a native of America and the West Indies, and is remarkable for its vocal powers and faculty for imitating the songs of other birds, as well as different noises which it hears. Its voice is very full and strong, besides being musical, and capable of any modulation, to the softest notes; from the clear tones of the wood-thrush it can reach the savage scream of the eagle. It feeds on berries and fruits, and builds its nest in the immediate vicinity of man.

Modality, *mo-dăl'-e-te*, in Phil., is a term used to denote the most general points of view under which the different objects of thought present themselves to the mind. These are possibility and impossibility, existence and non-existence, necessity or contingency.

Mode, *mode* (Fr., from Lat. *modus*), the melodious arrangement of the octave, which consists of seven essential natural sounds besides the key or fundamental. Although, in ancient music, the terms mode and key were synonymous, there is a great difference between them at the present day, the one denoting an octave with respect to the manner of its division, while the latter term is used with regard to its place in the scale of music. There are two modes only in modern music,—the major and the minor. The major mode is that by which the intervals between the second and third, and fifth and sixth, become half-tones, and all the others whole ones. In the minor mode, the intervals between the second and third, and fifth and sixth, become half-tones. Between these two modes there is also another distinction,—the major being precisely the same whether ascending or descending, while the minor, in ascending, sharpens the sixth and seventh, thus removing the half-tone between the fifth and sixth to between the seventh and eighth. In the Gregorian Chant there are eight modes (or, as we should now call them, keys), four of which are called authentic and four plagal. The authentic modes are the Dorian, Phrygian, Lydian, and Mixo-Lydian; these, according to Dr. Burney, answer to our D and A minor and C and D major. The plagal modes are the Hypo-Dorian, the Hypo-Phrygian, the Hypo-Lydian, and the Hypo-mixo-Lydian, which are also synonymous with our G and A minor and F and G minor.

Mode (Lat. *modus*, manner), in Phil., is the manner in which a thing exists; as, wax may be round or square, solid or fluid. "Modes," says Locke, "I call such complex ideas which, however compounded, contain not in them the supposition of subsisting by themselves, but are considered as dependencies on, or affections of substances." Modes are either simple or mixed, the former being only variations or different combinations of the same simple idea; the latter made up of several simple ideas of various kinds. They may be either internal, conceived to be in the substance, or external, taken from something not in the substance."

Modelling, *mod'-el-ing* (from Fr. *modeler*, to model), a term used in the Fine Arts, and applied to the art of forming a design in clay, or of making a mould from which works in plaster are to be cast. Modelling is essentially a practical art, and depends greatly upon the experience and artistic skill of the modeller. It is mostly executed with the fingers; and the tools employed are generally made of wood and wire, and so constructed as to be able to do what the fingers cannot perform. As wire tools can be fashioned into loops of various sizes and shapes, they are the most useful, and accomplish any required form without moving the clay on to any already finished part, the superfluous clay remaining in its place while the wire passes under it. Wire tools are most effective in working upon concave surfaces, such as the narrow folds of draperies. The wooden tools employed are of various shapes, and are composed of box and ebony. The wooden tools used in fine modelling are usually kept steeped in oil, as, by that means, the clay is less liable to adhere to them. Common potter's clay of the best quality is the clay used in modelling. It ought to be so wet as to be able to stand in a mass much higher than its own width without support, as it is then much more easily and quickly worked. The support of a figure in modelling is of great importance; the main parts of the trunk and limbs are built up on supports of wood-work; the arms, when not covered with drapery, may be made of twisted thick copper wire with small pieces of wood twisted in with it at short intervals, like the tufts in the tail of a kite. The whole model, indeed, should be built up on a complete skeleton of supports. Very little support is required in modelling a bust. The preservation of the uniform moisture of the clay is another essential part of modelling; it should never be allowed to dry, and while the modeller is at work and the figure exposed, especially in warm weather, it should be frequently sprinkled with water. A plasterer's brush is best adapted for this purpose, and superior to a syringe. In Smith's biography of Nollekens it is stated that when that sculptor was modelling a bust of George III. in the king's own presence, he kept his clay moist by dexterously using his mouth as a squirt at intervals. After the model is complete, the cast is taken from which the marble is sculptured or other casts made. The whole model, while wet, must be covered with three or four masses, or more if necessary, of plaster of Paris. When fixed and dry, the whole may be separated at the joints; and when the component parts are placed again together, the place of the original model is filled with plaster of Paris; and when the cast is well set, the mould can be carefully broken off in fragments. The cast is then exposed complete and finished. The ancient sculptors baked their clay models; but clay shrinks and cracks in drying: this plan is not so good as making plaster casts from the models. In making small models, for bronzes, the ancients used wax, which is still the modelling material used by goldsmiths and medallists. It is prepared by melting virgin wax with a small quantity of Venice turpentine and flake-white in fine powder. When coloured wax is required, a colour in fine powder must be substituted for flake-white. The tools employed are made of wood and ivory, and are similar in shape to those used in modelling in clay.

Moderator, *mod'-e-rai-tor*, is the name given to the president, for the time being, of the General Assembly of the Church of Scotland, and also of the Free Church. The Moderator is chosen annually. This is also the name of two officials of the university of Cambridge, appointed annually to perform certain duties. (*See* Cambridge University.)

Modern, *mod'-ern* (Fr. *moderne*, a corruption of Lat. *hodiernus*), is applied to what belongs to recent times. It is used in different senses. It is frequently used in contradistinction to ancient or classical; as modern philosophy, modern languages. Modern authors are said to be those who have written since Boethius; modern philosophy to have commenced with Galileo, and modern astronomy with Copernicus. "Modern civilization," says A. W. Schlegel, "arose from the blending together of the elements of northern origin and the fragments of antiquity." Modern history is sometimes applied to the whole period from the destruction of the Roman empire down to the present time; at other times, the term Middle Ages, or Mediæval history (*see* Middle Ages), is applied to the earlier portion of this period, and the term modern only to the later. The Germans often date the end of modern history with the French Revolution, and call the subsequent period "most recent history." Shakspeare uses the term for vulgar or common. As a substantive, it is chiefly used in the plural, for those who live, or have lived, in recent or modern times. To modernize, is to adapt something ancient to modern form or usage. A modernism is something unduly modern or unclassical.

Modulation, *mod-u-lai'-shun* (Lat. *modulatio*, forming anything to a certain proportion), that portion of the harmonic science which teaches the lawful transitions of harmony or melody from key to key, and from one combination to another. The exact meaning of the term *modulatio*, as applied by the ancients, is not known to us; but we may presume it to have signified the rise and fall of the voice, and the measures of the syllables in recitation and declamation. In modern music, *modulation* is of the highest importance: it may be divided into three kinds; viz., *natural* modulation, in which we pass from a given key to another closely related to it; *abrupt* modulation, by which are to be understood all changes into keys which are not analogous to the original key; and *enharmonic* modulation, which changes from one key to another entirely unanalogous to it, by means of an enharmonic interval.

Modus, or **Modus Decimandi**, *mo'-dus des-e-măn'-di* (Lat., mode of tithing), in Law, is a term applied to any customary mode of tithing, [illegible] rial usage, and differing from the [illegible] of one-tenth of the annual increase. It [illegible] pecuniary compensation, as twopence per acre, for the tithe of land; sometimes it is a compensation in work and labour, sometimes in lieu of a large quantity of crude or imperfect tithe, a less quantity at greater maturity is received; any means, in short, whereby the general law of tithing is altered and a new method introduced.

Modus Operandi, *op-e-răn'-di*, is a Latin term, denoting the manner of operating.

Mogul, The Great, *mo-gul'*, was the title by which the chief of the Mogul empire, founded in Hindostan by Sultan Baber, a descendant of Tamerlane, in the beginning of the 16th century, was known in Europe. The last of this title was Shah Allum, who died in 1806, when his great possessions fell chiefly into the hands of the East-India Company.

Mohair, *mo'-hair* (Ger. *Mohr*, Fr. *moire*), a material for textile manufactures, consisting of the hair of a goat which inhabits the mountains in the vicinity of Angora, in Asia Minor. The Angora goats, after completing their first year, are clipped annually in April and May, and yield progressively from one to about four pounds weight of hair. That of the female is considered to be of more value than that of the male, but both are mixed together for the market. Up to the year 1820, there was very little demand for this article in England, but now the quantity is very large. By a return of the Board of Trade, the total quantity of mohair imported into this country during the year 1856 was 2,928,411 lbs. In England, mohair is mostly spun, and to some extent manufactured, at Bradford, and also in a less degree spun at Norwich. Mohair yarn is also worked up in Scotland. The average price of Angora goat's hair is about 1*s*. 10*d*. per pound. A large variety of articles are made from mohair; amongst others, many kinds of camlets, which exhibit great beauty and brilliance of surface. It is manufactured into plush, and is also used for coach and decorative laces, for buttons, braidings, and other trimmings for gentlemen's coats. It is, moreover, made up into a light and fashionable cloth, suitable for paletots, &c. Mohair dresses were worn by ladies a few years ago; but they have been superseded by alpaca cloth and other similar materials. At Bradford, and other places, much ingenuity is displayed in combining mohair with two or more fibrous substances, to produce what are termed fancy stuffs.

Mohammedanism, *mo-hăm'-me-dăn-ism*, is the name commonly given, in Christian countries, to the religion established by Mohammed, born at Mecca, in August, A.D. 570, died at Medina 8 June, 632. Mohammedans call themselves by the name of Moslem, and their creed Islam, which means "full submission to God." The doctrines of Mohammedanism may, in large measure, be traced to the national religion of the Arabs and to those forms of Judaism and Christianity which existed in Arabia at the time of the prophet. The old belief that Mohammed was a base, heartless impostor, has, by the recent labours of Mohler, Carlyle, Irving, and others, been very much shaken if not entirely dispelled. Notwithstanding the many bad features of his character, if we look to the simplicity of his mode of life to the very last, his endurance for twelve years of every species of insult and persecution, his steady resistance of every offer of wealth and power made on the condition of his desisting from his endeavours, the conviction wrought upon those nearest him, we cannot think otherwise than that the man believed in what he taught. It is impossible to say how far an ardent imagination, acting under the belief of divine inspiration, and but little controlled by an intellect in many respects but narrow and limited, will lead one into all manner of wickedness. "I maintain," says Mohler, "that if one admits the possibility of any man's being able to give out his own individual religious impressions, ideas, and thoughts, without suspicion, for divine inspirations, I cannot perceive the impossibility of his considering God also to be the author of all his other inward impulses." Farther, we cannot think that Mohammed would have acted as his own recording angel and immortalized his offences in the Koran, had he been conscious of their wickedness. Mohammedanism is commonly regarded as half-way between paganism and Christianity; but it approaches much more nearly the latter than the former, and must be viewed as a great improvement upon the religions which it supplanted. It is a stern monotheism, opposed alike to pantheism and idol-worship, and throws aside with disdain all those gradations of æons or emanations by which God is approximated to man and man to God. Nothing exists but the Creator and the creation, the latter [illegible] angels, devils, genii, and every being intermediate between God and man. Regarding the connection between Mohammedanism, Judaism, and Christianity, we quote from Dean Milman's "Latin Christianity."—"The creation," he says, "[illegible] was strictly biblical; the history of man was that of the Old Testament recognized in the New, though not without a large admixture of Jewish legend. The forefathers of the Mohammedan, as of the Jewish and Christian religions, were Adam, Noah, Abraham; and to the old prophets of God, among whom were included Moses and Jesus, were only added two local prophets sent on special missions to certain of the Arab tribes, to Ad and to Thamud. Even Mohammedan fable has none of the inventive originality of fiction. There is scarcely a legend which is not either from the Talmud, or rather the source of most of the Talmud, the religious tradition of the Jews, or the spurious (not the genuine) gospels of Christianity. The last day, the judgment, the resurrection, hell, and paradise, though invested in a circumstantiality of detail, much of it foreign, so far as we can judge, to the Pharisaic notions of our Saviour's day, and singularly contrasting with the modest and

less material images of the New Testament, were already parts of a common creed. The Koran has scarcely surpassed the grosser notions of another life which were already received by the Talmudic Jews and the Judaising Christians,—the Chiliasts of the early ages. It only adapted this materialism to the fears and hopes of a Bedouin and a polygamous people. It may be doubted whether it goes beyond the terrific imaginations of the Talmudists in those minute and particular accounts of hell-fire which glare in all its pages. In its paradise it dwells on that most exquisite luxury to a wanderer in the desert—perennial rivers of cool pure water,—and it adds a harem to the joys of the blessed." The six great articles in the faith of Islam are neither repugnant to human reason nor to prevalent habits of thought, and, indeed, are the elemental truths of all religions. There are—1. Belief in a Supreme Being; 2. in his angels; 3. in divine revelation; 4. in his prophets; 5. in the resurrection and day of judgment; 6. in God's absolute decree, and predestination of good and evil. The [illegible] was the divine mission of Mohammed, [illegible] God. (See ALCORAN, vol. I.) Besides the Alcoran, Mohammedans generally receive the Sonna, or [illegible], which comprises acts and sayings of Mohammed not contained in the Alcoran. Mohammedanism, like Christianity, has numerous different sects, who differ from each other in their doctrines and forms of worship. There are five fundamental points of religious practice which are specially enjoined on Mohammedans; viz., purification, prayer five times a day, fasting, almsgiving, and the pilgrimage to Mecca. Washings and purifications are enjoined as necessary preparations for the duty of prayer, and for reading or touching the Koran, &c., for "the practice of religion is founded upon cleanliness, which is the one half of faith and the key o prayer." In every town the faithful are invited to prayer by the public crier, or muezzin, when th Moslem may perform his prayers in any decent place, except on Friday, when he is bound to perform them in the mosque. Fasting is regarded as a duty of so great moment, that the prophet used to say that it was the gate of religion, and that "the odour of the mouth of him that fasteth is more grateful to God than that of musk." Almsgiving is not strongly inculcated in general; but every Moslem who is not poor is obliged to give the fortieth part of his property to the poor. The pilgrimage to Mecca is deemed so necessary that it is said that he who dies without performing it "may as well die a Jew or a Christian." They are forbidden the use of wine or swine's flesh, and are prohibited from gaming and usury. On its first promulgation, the doctrines of Islam spread with amazing rapidity; and in twelve years the whole of Arabia had embraced that faith. The extension of the power of the Arabs soon carried this religion into other countries; and Syria, Persia, and Northern Africa were compelled to submit to their power and to receive their faith. At the beginning of the 8th century they crossed over into Spain, one province after another was speedily subdued, and for nearly 800 years the Saracens retained a dominion in that country. In Asia they advanced eastward to India and China; and in the former country they founded vast empires on the shores of the Indus and Ganges, which for a long time were strongholds of Islamism; but in the latter country their progress was soon stayed. Fresh energy was infused into the Moslem communities by the accession of the Seljook Turks; both they and their successors, the Osmanlis, voluntarily receiving Islamism from the very people they had conquered. The Ottoman rulers gradually undermined the Byzantine empire, which at length fell with the taking of Constantinople in 1453. The power of the Islam was now at its height; and for a time the Turks were the terror of Italy, Hungary, and Germany. Their power, however, soon began to fail. Sicily was lost to them; and in 1492 their last strongholds in Spain were taken. In the interior of Africa, Mohammedanism has long been making peaceable conversions. But while advancing among races inferior in civilization to the Mohammedans, this religion has been losing power wherever it has been brought into contact with Christianity. The consciousness of this superiority of the Christian nations has been spreading for years throughout the extent of the Mohammedan world, and has gradually kindled those sentiments of fierce and uncompromising hostility to the Christian name which have manifested themselves within the last few years in so bloody a manner in India, Arabia, Northern Africa, and Syria. These feelings, however, are not participated in by the more enlightened among the Mohammedans,—those who have seen and tasted the fruits of Christian civilization. They no longer exhibit any confidence in the power of the Islam. The total number of Mohammedans at the present time is estimated at about 160,000,000. In Europe they are almost confined to Turkey; and even there they form, in the European part of it, a minority of the population. They prevail in Asiatic Turkey, Persia, Afghanistan, Beloochistan, Arabia, and Tartary, and are largely represented in India, Asiatic Russia, and the Malay Archipelago, and to some extent in China. Their number in Asia is estimated at about 50,000,000. In Africa, Mohammedanism is still the prevailing religion in the entire north; and its rule extends far down eastward and into the centre of the continent, numbering, it is believed, not fewer than 100,000,000 souls.

MOIDORE, *moy-dore'* (Port.), an old gold coin of Portugal, value 26*s*. 11½*d*.

MOIRE, *moyre* (Fr., clouded, or watered), a term applied to a variety of manufactured textile goods. The production of this watered effect is usually called *moire antique*, and is principally used in making the broad silk for ladies' dresses. It is a superior kind of *watering*, and the different modes by which it is effected are kept secret by the *moireurs*, or calenderers. The effect is not produced during the spinning, weaving, or dyeing, but by passing the fabric through cylinders, hot or cold, embossed or plain, and, sprinkling the silk with water or not, by [illegible] layers of silk over each, either rectangularly [illegible], and other methods by which various [illegible] can be produced. Certain threads, either of the warp or weft, which happen to receive most pressure, have the most gloss; some are flattened, and the reflection from their surfaces becomes more or less glossy, according to the angle from which it is viewed. This produces the brilliant play of light and shade called *moire*, or *watering*.

MOIRE METALLIQUE, *moy'-re met-ul-leek'*, is a beautiful crystalline appearance given to tin plate by [illegible] metal a mixture of 2 parts of [illegible], 2 of [illegible] acid, and [illegible] water. As [illegible] appear, the plate is quickly washed, dried, and varnished.

MOLARS. (*See* TEETH.)

MOLASSES, *mo-läs'-ses* (Sp. *melaza*), a term applied to the brown viscid uncrystallized syrup produced in the manufacture of sugar. It is allowed to drain from the casks into a cistern before the sugar is sent away from the plantation. Molasses is employed in the preparation of spirits of wine. The syrups which remain after sugar [illegible] the processes of a refining-house are sometimes called *molasses*, but are more generally known as *treacle*. (*See* SUGAR.)

MOLE, *mole* (Dan. *mol*), (*Talpa europæa* of Linnæus).—This animal belongs to the family *Talpidæ*, of which it may be taken as the type. The moles are small quadrupeds, having their bodies nearly of a cylindrical form; the neck short and thick; the head tapering to a pointed snout; the fore limbs very short and strong; the fore feet of great breadth, being furnished with remarkably long, strong, and straight claws; the hind feet small, with slender claws; the eyes minute, and concealed by the fur; the tail short and slender, and the hair soft and velvety. Moles possess six incisors in the upper, and eight in the lower jaw; and seven grinders above, and six in the lower jaw. The canine teeth are large and angular, being compressed. Their pointed muzzle, strong fore feet, and sharp teeth, enable them to make their way underground without much difficulty. The common mole is about five or six inches long, and the colour of its fur is usually black, although the tint varies considerably from that colour down to white. Earthworms form its principal staple of food, although it also feeds on frogs, snails, and small insects. It lives the greater part of its time underground; and it labours incessantly in excavating galleries, up and down which it can run and procure its prey, as well as

escape its enemies. It is a native of Great Britain; but another variety of it exists in the Apennines, in Italy.

MOLECULAR ATTRACTION, MOLECULAR THEORIES, *mol-ek'-u-lar.*—In Chem., it is conceived that bodies can be divided into indivisible atoms, each having a definite uniform weight and general character. These ultimate particles are generally in this country called *atoms*, while those are called molecules which are constituent or aggregated into a heterogeneous whole. If the specific nature of these molecules were known, and the laws of the forces that retain them, whether these forces be of attraction or repulsion, it is evident that we should have the true key to tell the changes and sequences of the material universe. A number of attempts has been made to construct theories on this ground, sufficiently general to enable the inquirer to avoid restrictive conditions, and at the same time to afford a base for wide and important conclusions. One of the earliest explorers in the field of molecular theories was Boscovich, who asserted that matter did not consist of solid particles, but of mere mathematical centres of forces. Each body is supposed by his theory to be made up of a number of geometrical points, from which emanate forces following certain mathematical laws, in virtue of which the forces become at certain small distances attractive, and at certain [illegible] distances repulsive, and at greater distances again attractive. "From these forces of the points arise the cohesion of the parts of the same body, the resistance which it excites against the pressure of another body, and, finally, the attraction of gravitation, which it exerts upon bodies at a distance."—(Whewell's *History of Scientific Ideas.*) Mr. Grove, Q.C., more lately has followed up the subject in his investigations concerning the correlation of the [illegible] (which *see*). The most important [illegible] ject are those of Gauss on "Terrestrial Magnetism," and Dr. Simon George Ohm's "Contributions to Molec[illegible] Physics." In the latter work, Ohm supposes [illegible] ultimate molecules have both *simple* and *polar* powers, and on the ground of this hypothesis, attempts to educe a complete system from which the phenomena of light, heat, and electricity necessarily and harmoniously flow forth.

MOLECULE, *mo'-le-kule* (Fr.), a term used in Chem. to signify the constituent particles of bodies. They are divided into integrant and constituent molecules. Integrant molecules have similar properties to the mass, and are, therefore, simple or compound as the mass is either one or the other. Thus a mass of pure metal consists of integrant particles, each of which has metallic properties similar to those possessed by the whole mass. In the same manner, a mass of alloy consists of integrant particles, each of which is a compound of the different metals forming the alloy. When a compound integrant molecule is decomposed, we arrive at the constituent molecules. Oxygen and hydrogen are thus the constituent molecules of an integrant molecule of water.

MOLE-RAT (*Bathyergus*), a genus of animals that belong to the order *Rodentia* or *Glires*, and are natives of the Cape of Good Hope. It is about the size of a rabbit, and burrows underground, like its prototype the mole, throwing up large hillocks, which are exceedingly dangerous to travellers on horseback. There are two varieties of this animal at the Cape; one called the sand-mole (*B[illegible]*), just described, and the other the Cape mole-rat (*B. capensis*), which is called "*bless* moll" by the Dutch.—*Ref.* Baird's *Encyclopædia.*

MOLE, WATER. (*See* DUCKBILL.)

MOLINISTS, *mo-le'-nists*, is the name of a sect in the Roman Catholic church, which adopted the opinions of Molina, a Spanish Jesuit and professor of theology at Evora, in Portugal (1535—1600). In order to remove the difficulties attending the doctrines of predestination and free will, and to reconcile the jarring opinions of Augustines, Thomists, semi-Pela[illegible], and others, he had recourse to the hypothesis that the decree of predestination to eternal glory was founded upon a previous knowledge and consideration of the merits of the elect; that the grace from whose operations those merits are derived, is not efficacious by its own intrinsic power only, but also by the consent of our own will, and because it is administered in those circumstances in which the Deity, by that branch of his knowledge which is called *scientia media*, foresees that it will be efficacious. This *scientia media* is that foreknowledge of future contingents that arises from an acquaintance with the nature and faculties of rational beings, of the [illegible] in which they shall be placed, the objects that shall be presented to them, and the influence of these upon their actions. This doctrine was soon violently assailed, especially by the Dominicans; and at length Pope Clement VIII. appointed a congregation to investigate the matter. Opinion was so much [illegible], that the pope decided that [illegible] Molina and that of his opponents) might safely be taught in the Church. The Molinists, however, soon disappear, as other views involving the question of predestination and grace were advanced. (*See* JANSENISTS.)

MOLLA, *mol'-la*, is the name of a [illegible] and judicial officer among the Turks, superior to the cadis or inferior judges, and [illegible] and criminal jurisdiction ove[illegible] towns [illegible]. Over the mollas are the cadilesk[illegible]rs, or supreme judges of the empire, who sit in the div[illegible]

MOLLUSCA, *mol-lus'-ka* (Lat.), a class of animals belonging to the second great division of the animal [illegible], characteristically designated as being without a backbone. Molluscs may be briefly described to be animals covered with a soft moist skin, mostly forming over the back a duplication, free at the margin, and termed a *mantle*. The head is more or less distinct, is furnished with tentacles, and is often provided with two eyes. The shell is calcareous, mostly univalve; in some this covering is multivalve, in a few internal, and in others absent altogether. The organs of circulation and respiration are generally distinct, and the heart is always aortic. A nervous ring is also around the œsophagus, while the nerves proceed from [illegible], are various in number, and are principally [illegible] to the peripheral parts of the body. Cuvier supposes that the veins of molluscous animals perform the functions of absorbent vessels; their blood is of a white or bluish-white colour, and appears to contain a smaller portion of fibrin than vertebrated animals. These muscles are attached to various points of their skin, forming three tissues, which are more or less complex and dense. Their motions consist, principally, of contractions in different directions, which produce inflections and prolongations, or relaxations of their various parts, by which means they creep, swim, and seize upon objects, just as the form of those parts may permit, but as the limbs are supported by articulated and solid levers, they cannot proceed rapidly, [illegible]r by leaps. To continue the remarks of Cuvier, the [illegible]ritability of most of them is extremely great, and con[illegible] after they are divided. Their skin [illegible]aked, very sensible, and usually covered with a hum[illegible] that *oozes* from its pores. No particular [illegible]rgan [illegible] smell has been discovered in them, although they [illegible]ess that sense; it may, however, possibly re[illegible] the entire skin. All the acephala, brachiopoda, [illegible]da, and part of the gasteropoda and pteropoda are destitute of eyes. The cephalopoda, on the other hand, have the[illegible] quite as complicated as those of [illegible] blooded animals; they also possess the peculiarity of being supplied with organs of hearing; and they are the only class in which the brain has been discovered to be inclosed in a particular cartilaginous box. Nearly all molluscs have, more or less, a development of the skin termed the mantle, as before stated, and this is often narrowed into a simple disk, formed into a pipe, hollowed into a sac, or extended and divided in the form of fins. The *naked mollusca* are those in which the mantle is simply membranous or fleshy; most frequently, however, it forms in its thickness one or several laminæ, of a substance which is more or less hard, and is deposited in layers, always increasing in extent as well as in thickness, because the recent layers always outedge the old ones. Wh[illegible] this substance remains concealed in the thickness of the mantle, it is customary still to apply the term naked mollusca. Generally, however, it becomes so much developed that the animal, when contracted, can find shelter beneath it. In such a case it is then termed a *shell*, and the animal is said to be *testaceous.*

The shells are various, and differ in form, colour, surface, substance, and brilliancy. Some are calcareous, while others are horny, and they always consist of matter deposited in layers, and exuded from the skin under the epidermis, like the enamel covering the nails, horns, scales, and teeth of other animals. All modes of mastication and deglutition can be traced in the mollusca. Their stomachs are sometimes simple, at other times multiple, and frequently provided with a peculiar anatomy, while their intestines are variously prolonged. They commonly have salivary glands, and always a large liver, but neither pancreas nor mesentery; several, also, have secretions which are peculiar to themselves. Their modes of generation vary considerably. Several possess the faculty of self-impregnation; others, although hermaphrodites, have need of a reciprocal intercourse; while many, indeed, have the sexes distinct and separated. Some, again, are viviparous, others oviparous; the eggs of the latter are sometimes enveloped with a shell, more or less hard, but sometimes covered with a simple viscosity. These varieties of the digestive and generative processes are found in the same order, and sometimes in the same family. The mollusca, in general, appear to be animals that are but slightly developed, possessed of but little industry, and which are only preserved by [illegible] tal tenacity. Molluscs [illegible] both animal and vegetable, into food, which some take in a decomposed state, while others will only eat such substances as are perfectly fresh. Some are terrestrial, while others inhabit only the sea and fresh waters a few varieties are also amphibious; but this class is much restricted in number. The uses and advantages of molluscs are various. Some supply food to man, while others supply nutritive provender to birds and fishes. Their shelly coverings are also converted into useful articles of commerce, and the celebrated Tyrian dye of the ancients was made from the veins of different shells termed *purpura* by the Romans. The molluscs are divided into numerous classes, [illegible] their structure; those possessed of a [illegible] valve are termed univalve mollusca, and are furnished with a distinct head; from which circumstance they are called *encephalous*. These are divided into three classes, the first of which is termed,—1. *Cephalopoda*, or *cuttle-fishes*. These have their feet, or, strictly speaking, arms, attached to the head, forming a circle round the mouth. (*See* CUTTLE-FISH.)—2 The next class is the fam. *Gasteropoda*, or *snails*, which Cuvier divides into several orders or divisions, according to the structure of the gills, as the *Pulmonaria*, *Nudibranchiata*, *Inferobranchiata*, *Tectibranchiata*, *Heteropoda*, *Pectinibranchiata*, *Scutibranchiata*, and *Cyclobranchiata*.—3. The third class of the univalves is termed *Pteropoda*, which swim in the sea with a pair of fins that extend outwards from the sides of the head. The subdivision *Clio* of Linnæus, of this class, is the type of the whole [illegible] the family Pteropoda are mostly [illegible] The *acephalous*, or bivalve molluscs, ar[illegible] two classes,—1 the *Conchifera*, and secondly the *Brachiopoda*, both of which classes have been united into one order by later naturalists. The respiratory apparatus of these is externally situated, and is placed either between the mantle and the body in the form of plates, or in the substance of the mantle itself. Besides the several classes which have been catalogued, there is yet another, called the *Tunicata*, which are destitute both of head and shell. Cuvier, in his supplement to Mollusca, in his great work, says that the diseases of these animals are not very numerous, but yet very little is known about them; and he puts forward the query whether oysters in a state of greenness, as they are often observed to be, ought not to be regarded as unhealthy.—*Ref.* Cuvier's *Règne Animal*; Hoeven's *Handbook of Zoology*, &c. &c.

MOLOCH, MOLECH, or MELCHOM, *mo'-lok*, was the national god of the Ammonites, and is frequently mentioned in Scripture. It is highly probable that the Hebrews were addicted to the worship of this deity before they came out of Egypt; and Moses in several places forbids them, under pain of death, to dedicate their children to Moloch. Solomon, seduced by his foreign wives, built a high place for him; and Manasseh imitated his impiety by making his son pass through the fire to Moloch. The idolatry continued from that time, chiefly in the valley of Tophet and Hinnom, till the captivity, after which all traces of this worship disappear. There are various opinions as to what is meant by "causing to pass through the fire." Some think that the children leaped over a fire sacred to the idol; others that they passed between two fires; and others that they were really burned in the fire by way of sacrifice to the god. The last opinion seems the most probable, and to accord most with portions of Scripture in which it is mentioned. According to some accounts, the image of the god was of brass, seated on a throne of the same metal, and with arms extended, as if to embrace some one. When sacrifices were offered to him, the image was heated from within, and the miserable victim was placed within the arms, its cries being drowned by a great noise of drums and other instruments. The place where these sacrifices were offered was so abhorrent to the minds of the later Jews, that they employed its name to designate the place of future torment. Moloch is sometimes identified with the Phœnician god Baal.

MOLUCCA BERRIES. (*See* ELÆOCARPUS.)

MOLYBDENUM, *mo-lib'-de-num* (Gr. *molubdaina*), in Chem., symbol Mo, equivalent 46, spec. grav. 8·625,—a rare metal found in nature principally as the bisulphide, in Bohemia and Sweden. It is also found oxidized in combination with lead, as molybdate of lead. The metal is obtained by roasting the bisulphide in excess of air, and mixing the remaining molybdic acid into a paste with oil and charcoal. If this be exposed to the heat of a smith's forge, it is reduced to the metallic state as a white, brittle, difficultly fusible mass. It f[illegible],—the protoxide, deutoxide, and teroxide. The two former are possessed of basic properties, and form salts; the latter is molybdic acid, the only important salt of which is the phospho-molybdate of soda, which is a test for ammonia. The sulpho-molybdates of the alkalies are beautiful iridescent metallic salts, rivalling in brilliancy the rosaniline and murexide compounds. Its other compounds are unimportant.

MOMENTUM, *mo-men'-tum* (Lat.), in Mech., a term applied to express the quantity of motion in a moving body; in other words, the [illegible] the same. The momentum is always equal [illegible] velocity multiplied into the weight. (*See* IMPETUS.)

MONACHISM, *mon'-ă-kizm* (Lat. *monachus*, a monk, from Gr. *monachos*, solitary), is used to denote the monastic system of life which has prevailed in the Church from a very early period. Some Protestant historians are of opinion that monachism was originally foreign to primitive Christianity, being adopted from the Alexandrian philosophy; others, again, hold that its rise was owing t[illegible] within the Church itself, particularly the hardships to which it was exposed, by which many of the believers were driven from their homes and compelled to seek for safety in desert places. Long before the rise of Christian monachism, the Essenes in Palestine, and the Jewish sect of the Therapeutæ in Egypt, seem to have formed regular communities of ascetics. Christian monachism may be regarded as having its first beginning in the 2nd century, when we find some ascetics who lived in celibacy and voluntary poverty, and shunned intercourse with the world. They, however, lived isolated and not in communities. The father of monachism proper is generally agreed to have been Antony, who, in the year 305, collected a number of ascetics into an associated community in Egypt, and regulated their mode of living by fixed rules. His disciple Hilarion soon after undertook the same thing in Palestine and Syria. Almost at the same time, Aones, or Eugenius, with his associates Gaddanas and Asyaus, introduced this mode of life into Mesopotamia and the neighbouring countries. These were imitated by many others with so much success, that in a short time all the East swarmed with persons who, abandoning the occupations and conveniences of life, and all intercourse with society, pined away amidst various hardships, hunger, and suffering, in order to maintain a closer communion with God and his angels, ignoring the fact that they were living in opposition to the true spirit of Christianity, which enjoins Christians to live for the benefit of others, and to let their light so shine

before the world that others seeing their good works may glorify God. From the East, this austere discipline passed into the West, and first into Italy and the adjacent islands; but who conveyed it thither is uncertain. Afterwards, St. Martin, the celebrated bishop of Tours, erected some monasteries in Gaul, and by his example and discourses produced such an effect, that two thousand monks are said to have assembled at his funeral. This way of life gradually extended over the other countries of Europe. The ancient monks were not like the modern, distinguished into orders, but took their names from the places which they inhabited, or were distinguished by their different mode of living; as—1. the Anchorets, who lived alone in private cells in the wilderness; 2. the Cœnobites, who lived in community, several of them in the same house, under the direction of a superior; and 3. Sarabites, or strolling monks, who had no fixed rule or residence. The first and last of these came gradually to be absorbed in the regular Cœnobite system, which was principally regarded by the Church, and most under its direction. Originally, monks were no more than laymen, whose office, says Jerome, "is not to teach but to mourn." Not only were they prohibited the priesthood, but priests were expressly prohibited from becoming monks. Pope Siricius was the first who called them to the clericate, on the occasion of a great scarcity of priests which the Church was then supposed to labour under; and since that time the priesthood has been usually united to the monastical profession. The manner of admission to the monastic life was usually by some change of habit or dress, not to signify any religious mystery, but only to express their gravity and contempt of the world. No solemn vow or profession was required at their admission, but they underwent triennial probation, during [illegible] time they were inured to the exercises of [illegible] life. If after that time they chose to continue the same exercises, they were without further ceremony admitted into the community. They were also at liberty to return at any time to secular life again. Nor was any solemn vow of poverty required, though it was usual for men voluntarily to dispose of their estates for charitable purposes before they entered into a community. The monasteries were commonly divided into several parts, and proper officers appointed over each of them. Over every ten monks was a *decanus*, or dean, and over every hundred a *centenarius*. Above these were the *patres*, or fathers of the monasteries, called also the abbots or presidents. The business of the dean was to exact every man's daily task, and to bring it to the *œconomus*, or steward, who gave a monthly account of it to the [illegible] the monasteries at that time [illegible] all the monks were obliged to exercise themselves in bodily labour, so as to maintain themselves and not be burdensome to others. The monk that did not work was viewed as no better than a covetous defrauder. Towards the close of the 5th century, the monks, who had formerly lived only for themselves in solitary retreats, and had never thought of assuming any rank in the Church, came to be gradually endowed with such honourable privileges and wealth that they soon found themselves to be in a position of great power and influence. The fame of their piety and sanctity was very great, and the passion of erecting edifices and convents for their benefit was carried beyond all bounds. A new epoch in the history of western monachism began with Benedict of Nursia, whose rule (529) came gradually into general use, transforming the previously independent communities into a hierarchical religious order. It became the bond of union for most of the western convents; but the many favours received from church, state, and individuals, facilitated the growth of moral corruption to a great extent, and called forth repeated attempts at reform; so that for many centuries the history of monachism presents a continued struggle of reformers with the laxity, indifference, or immorality obtaining in a greater or lesser number of the convents of their times. Among the earlier of these reformers were Benedict of Aniane, who died 821, and whose commentary on the rule of St. Benedict enjoyed a high character; Benno, who became abbot of Cluny 91[illegible], and laid the foundation of the congregation of Cluny; Romoald, who founded the congregation of Camaldoli in 1023; and Gualbert that of Vallombrosa in 1036. Towards the end of the 11th century arose the Cistercian and Carthusian orders, the order of St. Anthony, the Hospitallers, &c. The warlike spirit of the times brought about a union of the monastic with the military life; and hence arose the various military orders; as the Knights of St. John, the Templars, the Teutonic Knights, the orders of St. Jago, Calatrava, Alcantara, &c. The large increase of orders called forth much opposition, and the council of Lateran, in 1215, passed a resolution that no new order should be established. Notwithstanding this prohibition, there almost immediately arose an entirely new class of orders,—the mendicants, including the Franciscans, Dominicans, Carmelites, Augustinians, and others, who inaugurated a new era in the history of western monachism. They directed their attention more particularly to the lower orders of society, among whom they became very popular. They spread with great rapidity, and had many important privileges conferred on them by the popes. Several of their members filled the highest offices in the Church, even to the papal chair. In the 11th century, a general degeneracy of monachism commenced, until at length the name of monk came to be almost [illegible] with ignorance, rudeness, and every [illegible]. The dawn of the Reformation [illegible] had an important influence on this state of things, and strong efforts were made to enforce a more strict observance of the rules of the respective orders. The council of Trent passed a number of regulations for the internal management of religious houses. Several new orders were formed upon improved rules, the most famous of which is that of the Jesuits, who were, more than any other order, under the absolute power of the pope. Since the Reformation, however, monachism cannot be said to have manifested any inherent vitality or power; and with the advance of modern civilization its highest meaning and only conservative use are gone. An account of the principal monastic orders will be found under their own names in other parts of this work. The number of monastic institutions in 1860 was estimated as follows:—Male orders and congregations, 83, with with about 7,065 establishments and 100,000 members; female orders and congregations, 94, with 9,247 houses and a little more than 100,000 members. At present they are most numerous and influential in France, and after it in Belgium. In Austria since 1848 they have met with much support and encouragement. In Spain and Portugal they have been almost entirely suppressed; and in Italy, in consequence of recent [illegible], they have been very much reduced.—*Ref.* M[illegible]'s, Neander's, and Milman's *Church Histories*; Helyot's *Histoire des Ordres Monastiques*; Dorm[illegible] *Geschichte der Mönchsorden*, Montalembert's *Les Moines de l'Occident*.

MONAD, *mo'-nad* (Gr. *monas*, a unit).—In Nat. Hist., this term is given to the simplest kind of minute animalcules. In Metaphysics, the word, according to Leibnitz, is used to denote a simple substance, having no parts, a compound substance being an aggregate of simple substances or monads. The basis of the monad [illegible] the various philosophical systems of [illegible], and Epicurus. Leibnitz was the first to arrange the different theories in a system.

MONARCHIANS, *mo-nar'-ke-anz*, in Eccles. Hist., were a sect of Christians that arose about the end of the 2nd century, and insisted upon the unity or oneness of God, as opposed to the commonly received doctrine of three persons in the Godhead. The upholders of this doctrine, however, differed greatly from each other on other points, mo[illegible] the nature of Christ; some of [illegible] held that he was God himself; others, that he [illegible] of the Deity, but that he did not exist as a distinct person before his incarnation; whilst others regarded him only as a mere man. Their opinions were thus not unlike those of the Unitarians of the present day.

MONARCHY, *mon'-ăr-ke* (Gr. *monos*, alone, and *arche*, government), in Pol., is that form of government in which the supreme power is vested in the hands of a single person. Of the three forms of government,—democracy, aristocracy, and monarchy,—the last is the most powerful; all the sinews of government being

knit together and united in the hand of one person, who can thus carry out his plans with promptitude and decision. In some monarchies, the will of the sovereign is uncontrollable; in others, his authority is restrained by laws. The former are termed despotic or absolute, the latter constitutional monarchies. "To a constitutional monarch the laws are not manacles, but garlands. They adorn rather than oppress him." "The well-being of a people is perhaps never so perfectly secured as under a constitutional monarchy, which is, in fact, a republic with safeguards against revolution; or, rather, a commonwealth under which the people do not learn the 'sacred right of insurrection,' but accomplish all the necessary revolutions quietly, surely, and according to law."—(Dr. Doran, in *Encyclopædia Britannica*.) Some monarchies are hereditary, descending regularly from father to son; others are elective, where, on the death of a monarch, his successor is appointed by election, as was the case in Poland before its dismemberment. Historians usually reckon four grand or universal monarchies,—the Assyrian, Persian, Grecian, and Roman. The first of these commences with Ninus, the son of Belus, who reigned in Assyria, built Nineveh, and captured Babylon about B.C. 2060. On the death of Sardanapalus, the Assyrian empire was split into three kingdoms,—the Median, Assyrian, and Babylonian. These monarchies continued separate until B.C. 606, when Assyria was united to Media; and in 538 the Babylonian kingdom was brought to an end by the conquest of Cyrus, who established the second great monarchy, called the Persian. This stood under alternations of glory and disaster till the conquering Alexander subjected the country and laid the foundation of the Greek empire, B.C. 331. That part of the Greek empire which comprised Macedonia, fell before the Roman general Æmilius Paulus, and was made a Roman province; the king, Perseus, and his sons, being carried captive to Rome. The Roman monarchy, if dated from the building of the city, commenced B.C. 752. There first reigned seven kings, and then consuls were appointed, B.C. 509. The imperial monarchy commenced in the person of Julius Cæsar, B.C. 48. On the death of Jovian, A.D. 363, the Roman empire was split into two divisions,—the Western and Eastern. The former fell with the deposition of Romulus Augustulus by Odoacer, king of the Heruli, A.D. 476, the latter, as the Byzantine empire, continued down to 1453.

Monarda, *mo-nar'-dă* (after Monarda, a Spanish physician), in Bot., a gen. of the nat. ord. *Labiatæ*. The species *M. punctata*, commonly called horsemint, is used medicinally in the United States. This herb resembles the ordinary mints in its properties, but it is more stimulating. *M. fistulosa* is said to be febrifugal. The leaves of *M. didyma* and *purpurea* are used as tea in North America under the name of Oswego tea: the flowers of the former are said to contain the same colouring principle as cochineal.

Monastery, *mon'-ăs-ter-e* (Fr. *monastère*, Low Lat. *monasterium*), is a religious house built for the reception of religious persons, whether it be abbey, priory, nunnery, or the like. More properly, however, it is applied only to the houses of monks, mendicant friars, and nuns, the rest being called religious houses. (*See* Monachism.) The following calculation has been made as to the number and wealth of the religious houses in England, dismantled and scattered, from first to last, at the time of the Reformation, so far as any evidence exists:—

Lesser Monasteries, of which we have the valuation	374
Greater Monasteries	186
Belonging to the Hospitallers	48
Colleges	90
Hospitals	110
Chantries and Free Chapels	2,374
Total	3,182

Besides the friars' houses, and those suppressed by Wolsey, and many small houses of which we have no particular account. The clear yearly revenue of the several houses at the time of their dissolution, so far as we have any account, seems to have been as follows:—

	£.	s.	d.
Of the greater monasteries	104,919	13	3
Of the lesser monasteries of which we have the valuation	29,702	1	10
Knights Hospitallers' head house in London	2,385	12	8
Twenty-eight of their houses in the country	3,026	9	5
Friars' houses of which we have the valuation	751	2	0
Total	£140,784	19	2

Taking into account the value of money at the time,—at least six times as much as at present, and considering that the estimate of land is generally supposed to have been much under the real value, and making some allowance for omissions, the entire revenues of these houses must have been enormous.

Moncrieff System of Artillery.—The main principle of the Moncrieff system of artillery is the complete protection afforded to the gun and artillerymen in action with the enemy. The inventor thus speaks of his system:—"My solution gives a system capable of mounting the heaviest artillery, while it simplifies the vexed question of fortification. It gives protection without the expense of using iron, and free lateral range to the guns without exposure. Instead of trying to meet force by force, I make my guns bow to the inevitable conditions which science has imposed; and instead of wasting energy, money, and skill in attempts to raise a buttress against the new artillery, I employ the hitherto destructive force of recoil to lower the gun below the natural surface of the ground, where it can be loaded and worked in security and comfort; and at the same time I have made that destructive force so much my servant that I compel it at my pleasure to raise the gun again into the fighting position whenever it is required." Captain Moncrieff's system consists of three parts, and with regard to them we cannot do better than quote his own words:—"1. Of various contrivances for dispensing with a raised parapet for artillery, by means of counterweights, &c. 2. Of arrangements for placing the artillery so mounted in favourable positions. 3. Of arrangements for laying, sighting, range-finding, internal communication, &c., adapted to the altered conditions and requirements of a position thus armed. The system may be said to have two aspects—an artillery and an engineering one,—both of equal importance; and in applying it properly both must be kept in view, in order to get the full advantage it is capable of yielding. The gun-carriages have to be made with those appliances which will best suit them for the positions in which they will be placed; and, on the other hand, the works themselves should be designed in such a manner as to get the greatest results from the artillery mounted on the new plan. It is difficult fully to appreciate the radical change of conditions imported by the new system without actually attempting its application. Up to the present time, the trace of works and the systems on which they were formed were based, to a great extent, on conditions that are now removed. These conditions, simple as they were, guided nevertheless the pencils of all military engineers, from Vauban downwards, and gave form to those many-lined and cunning designs for flank defence characteristic of modern fortification. An exterior slope, a pierced parapet, guns cramped in their action and lateral range; such were the conditions which are now swept away by the new system. The problem of fortification is thus far simplified. This advantage, however, would probably not have been sufficient to force on a cordial recognition of the new system at present, had it not been for the wonderful advance that has taken place in our own time in the science of artillery. The penetration and precision of direct rifle fire from modern ordnance called for stronger parapets and smaller embrasures. The old earthen or masonry parapet, which was sufficient to resist ordinary spherical shot, could not withstand the elongated rifle projectiles; and that parapet had not only ceased to be a protection, but actually became a danger, as it just offered sufficient resistance to burst large shells, or was thrown in upon the detachments by solid pro-

jectiles. These potent reasons compelled the use of iron shields, casemates, and turrets. The great progress, however, in the science of artillery since 1855 has been restricted mostly to the guns themselves. The carriages for these guns were certainly improved, or they would not have been sufficient for their work; but that improvement was confined to increased strength, and to various methods of stopping the recoil by friction, by the use of compressors, &c." It is well known that Captain Moncrieff's designs had for their object the utilization of that terrible recoil which had hitherto been one of the great difficulties of artillerists. Formerly the tremendous spring backward of the gun could only be checked with difficulty and great wear and tear to the carriage. Captain Moncrieff, in his first design, so arranged his apparatus that the recoil lifted a weight smoothly and without friction. The gun and the weight were held in the position arrived at by a catch until the gun was loaded and ready to fire again. It could even be laid upon the object while it was down below the parapet; then the catch was released, the weight sank, and the gun rose. The shot was delivered, and down sank the gun again out of sight. This was all very successful, and a large number of carriages for 7-inch guns have been made upon the principle. The next point was to design a carriage for the 9-inch 12-ton gun. In the case of the 7-inch, the gun only descended 3 ft. 6 in. from its firing to its loading position. It might be said that this is not enough, though considerably more than the ordinary distance of garrison guns below the parapet, and the parapet, moreover, is cut out in the form of an embrasure in front of guns on ordinary garrison carriages. In the 9-inch carriage Captain Moncrieff has answered this objection, together with some others. The gun descends six feet by the recoil and additional security is given to the men by the counterweight, which stands over their heads while they are loading. All the gearing is brought closer to the ground, into a more convenient position for the detachment. But, unfortunately, the size and weight of the Moncrieff apparatus first designed increases in a high proportion to that of the gun, and when the principle came to be applied to the heaviest ordnance, it was manifest that some new application of it must be found. The brain of the inventor teemed with ideas, but it was some time before those ideas took a practical form. In 1868, Captain Moncrieff laid before General Sir R. J. Dacres, K.C.B., a number of designs, one of which was for a carriage with parallel action and fixed fulcra. Last year similar designs, only improved and brought up to date, were submitted to the Director-General of Ordnance. The carriages will be much lighter and more compact than the present ones, the recoil being received on springs instead of lifting a weight. It would, however, be a great mistake to suppose that Captain Moncrieff's inventions are confined to a few designs for carriages. He comes forward as the advocate of the whole system of coast defence. It is too late to alter the Breakwater Fort at Plymouth, or to criticise the designs for granite forts which have been already executed in many parts of England; but there is yet plenty of room for the application of the Moncrieff system, both in the iron forts for Portsmouth, and in many places intended to be defended by earthworks. The inventor was called upon, on the 15th of June, 1869, to give in designs for the defence of several positions, the most important of which is Cliff End, Isle of Wight. It is rather hard to expect a single man, and that man not a professional soldier, to understand all the complicated designs which take up the attention both of artillerymen and engineers; and we shall not feel surprised if we learn hereafter that Captain Moncrieff has made some mistakes in his work as a military engineer; but it is certain that he has designed the defence of a position for twenty heavy guns, and that his arrangements are cheap and formidable. He has gone a step further, and developed a system already in application at Copenhagen and other places, for the combined defence of harbours. By means of the electric telegraph and charts prepared beforehand, it will be possible for men posted in central positions of observation to communicate exactly the position of ships endeavouring to advance, and the direction in which they are going, to the officers in charge of every gun posted round the harbour. Those officers will know at once the range and elevation to be given to the guns. The heavy pieces of ordnance can be laid on a spot in the path of the advancing vessel; not a single man need expose himself; all that will have to be done is to lay the gun from the place of safety beneath it, and then watch a small mirror till the moment when the enemy's vessel appears in it. At that moment the word will be given, the gun will rise, peer for a second or two over the parapet, discharge its shot, and, sinking down beneath the ground, be loaded and ready again before the smoke has had time to clear away. Captain Moncrieff is of opinion that the improved artillery applied in earthworks made thoroughly efficient on the new system, together with the facilities which the existing networks of railways should supply, ought to enable us to meet any attack, however sudden, or of whatever magnitude.

MONDAY, *mun'-dai* (Sax. *Monandæg*, Ger. *Montag*, Lat. *lunæ dies*, Fr. *lundi*), is the name of the second day of our week; so called from being formerly regarded as sacred to the moon.

MONGOLIAN RACE, *mon-go'-le-an*, is one of the great ethnological divisions of the human race. (*See* ETHNOLOGY.)

MONEY, *mun'-e* (Sax. *mynet*), the common medium of exchange in civilized countries, by which the value of commodities is estimated. Barter is naturally the first form in which commerce is carried on; but this mode of dealing is only suitable to a very rude state of society. Although, in every nation, this mode of dealing was the foundation of business, it was obliged to give way in time. Without the use of money of some kind, exchanges would soon have been embarrassed, and the divisions of labour very imperfectly established. In different countries, and at different times, a great variety of commodities has been employed to serve as money; but, before long, it was found that no commodity could be used as money unless it possessed certain properties:—First, that it should be a material having a value of its own; second, that it should be of such a value that every man should accept it in exchange for his property; third, its value should be readily ascertained. When such a material as this is moulded into a particular form, and stamped with a mark which denotes its value, so that it is exclusively employed as an exchange for articles of value, it is called money, in distinction from those articles which have value, but are not used as a medium of exchange. At all periods, and in all countries, the metals seem to have been used to serve the purposes of money. Many other articles have been used; such as paper, in the more highly civilized nations, and cowrie-shells in Africa; but in all, the metals form some portion of the currency. Among the Chinese, Egyptians, Persians, Hebrews, Greeks, and Romans, metal was employed as money. Metals are of great utility, and have always been eagerly sought after for various useful and ornamental purposes; but the precious metals gold and silver are the principal objects of desire. These, with some other metals, easily changed from articles of value to articles of exchange. All nations as they advanced in trade gave the preference to them, for the following reasons:—First, they derive value from the smallness of their quantities compared with the demand for them in the ornamental and useful arts; second, they are not liable to corrosion and destruction by use; third, they are susceptible of minute division, and may be used in small quantities or masses; fourth, they are easily transported, and their transportation to any distance costs only a small part of their value; fifth, the quantity is increased by labour. For a universal currency, the advantage of using the precious metals is still greater, when it is not left for private individuals to divide, weigh, and fix the value of pieces of metal, but persons are appointed by law to decide what pieces shall be circulated as money, to stamp them so as to fix their weight and fineness, and to furnish them with the superscription of the authority by which their issue is legalized. The pieces of metal so circulated are called *coins*. (*See* MINT.) In rich countries, the three metals, gold, silver, and copper or bronze, are very convenient substances for the

manufacture of coins, on account of the differences in their relative value. Gold coins, containing a high value in a small compass, are convenient for large payments; silver coins for smaller payments; and copper, or bronze coin, for those of less value: while all the larger coins are multiples of the smaller. Payments of larger amounts, however, cannot be made conveniently in coins. Promissory notes, bills, and various forms of credit, have, therefore, been used as substitutes in this and other countries. These substitutes are sometimes improperly called *money*. Promissory notes, or bills of exchange, are only of the same value as real money when they can be readily exchanged for coin; they lose their value as the credit of their issuer sinks. This must be the case with *paper-money*, as it is called, and with all coins issued at a higher value than their real value. (*See* the articles on BANK, BANKING, BILL OF EXCHANGE, EXCHANGE, CURRENCY, &c.) In all countries where the use of coins has once been adopted, all values in contracts and other arrangements are rated or estimated in money; and in most cases it is enacted that coins of the legal or standard weight and purity shall be legal tender, and to enact that no legal proceedings shall be instituted on account of any debt or pecuniary obligation against any individual who has offered to liquidate the same by payment of an equivalent amount of the coin recognized by the country. The metal of which English silver coins are made consists of a mixture of pure silver and alloy, every 12 oz. containing 11 oz. 2 dwt. pure silver and 18 dwt. alloy. These 12 oz. are coined into 66 shillings, so that the money pound of 20 shillings contains 1614·515 grains of pure silver and 1745·454 grains of standard silver. The fineness of gold is estimated by carat grains, equivalent to 2½ dwt. troy; the finest gold is said to be 24 carats fine. The present standard gold consists of 11 parts fine gold and 1 part alloy. The sovereign, or twenty-shilling piece, contains 113·001 grains of fine gold and 123·274 grains of standard gold. In order to prevent the great inconvenience and confusion which would necessarily arise were private individuals to coin money, the governments of nearly every civilized country have not only taken upon themselves the supply of the coins in circulation (*see* MINT), but have found it necessary to inflict severe penalties on the forging of coin or the fabrication of counterfeit coin. It is found, however, that the best method for the prevention of forgery lies in the improvement of the fabric of the coins and the perfection of the dies and machinery.

MONIMIACEÆ, *mon-im-e-ai'-se-e*, in Bot., a small nat. ord. of *Dicotyledones*, sub-class *Monochlamydeæ*, consisting of eight genera of fragrant trees or shrubs, chiefly natives of South America, but found also in Australia, Java, the Mauritius, and New Zealand. The flowers generally resemble those of *Atherospermaceæ* (which *see*), but they differ in always being unisexual, in the longitudinal dehiscence of the anthers, and in the absence of feathery styles to the fruit.

MONITEUR, *mon-e-tuhr'* (Fr.), is the name of one of the most celebrated of the French newspapers. It was commenced as a daily journal at Paris on 24th Nov., 1789, under the title of *Gazette Nationale, ou le Moniteur Universel*. At first it was a simple gazette, without any official character; but on the 7th Nivose, of the year VIII. (1799), it was declared an official organ, and it still continues to be the official organ of the French government. Since 1811, it has dropped the title *Gazette Nationale*, and retains only that of *Moniteur Universel*. It contains, in addition to news foreign and domestic, literary notices, &c., not only the official ordinances and documents of the government, but also such political information as the government intends to be regarded as official. It now comprises upwards of 100 thick folio volumes, and contains a vast amount of valuable information connected with the history of France. Entire sets of it are now rare and very valuable. In 1796, an introductory volume was published "contenant un abrégé des anciens états-généraux, des assemblées des notables et des principaux événements qui ont amené la révolution;" also in 1828, "Tables chronologiques du Moniteur Universel."—*Ref.* Bidault, *Notices historiques et bibliographiques sur la Collection et les Tables du Moniteur depuis son origine jusqu'à ce jour*. Paris, 1838.

MONITOR, *mon'-e-tor* (Lat., one who warns), a gen. of large lizards having teeth in both jaws, and none on the palate. The greater part have the tail compressed laterally, as an adaptation to their aquatic habits. The first of the two distinct groups into which the genus is divided bears the name of Nilotic monitors, their chief characteristics being numerous small scales upon the head and limbs, and a keel above the tail, formed of a double range of projecting scales. The second group carries angular plates upon the head, whilst the body and tail carry large rectangular scales. The monitors are found in most parts of the world [illegible] name is said to be derived from their making a whistling sound as a warning of the approach of crocodiles and alligators, whose haunts the monitors frequent.

MONK. (*See* MONACHISM.)

MONKEY, *munk'-e* (Ital. *monicchio*).—In the article on MAMMALIA the reader will find that the larger section of the animal creation has been divided into various classes in a descending scale, from the highest animal, man, to the lowest group of the cetaceans or whale tribe. Ranking next to man are the Quadrumana, under which heading apes, baboons, gorillas, and monkeys are generally classed. As the other subdivisions have been already described in distinct articles, the present one will be only devoted to the consideration of the monkeys proper, whose technical characteristics will be found given under the article SIMIADÆ. The true monkeys, the *sapajous*, are only such as have prehensile tails, and are inhabitants of South America exclusively; but as the name has become extended in its signification, the monkeys of the whole world may as well be described at the same time. The monkeys form by far the largest portion of the quadrumana. The *sapajous* are very active, climb well, and by the aid of their tail, which is as good as another hand; they can spring from tree to tree in the vast forests of South America with inconceivable rapidity and agility. The fore-hands, however, are not so perfectly organized as those belonging to the monkeys of Africa, the thumb being longer and more on a line with the other fingers. The facial angle of the *sapajous* is 60°, which forms a marked contrast to others of the species. They are small in size, and very playful. Foremost amongst them may be placed the weeper (*Cebus Apella*). Its fur is of a rich olive-colour, inclining to golden on the lighter parts. There is also the horned sapajou (*Cebus fatuellus*), the large-headed sapajou (*Cebus monachus*), and more than fifteen or sixteen other species. To turn to the monkeys of Asia and Africa, we find a great change in the generic character. The first variety is the spotted or Diana monkey (*Cercopithecus Diana*), a native of Congo and Guinea, and one of the most lively and playful of the whole tribe. It has a long white beard, and the upper parts of the body are of a reddish colour, marked with white specks, and the tail is about as long as the body. The Green monkey (*Cercopithecus sabæus*) is one of the most abundant of the group, and is oftener seen in a state of captivity. It is a native of the Cape de Verde Islands and of the continent of Africa. In its disposition it approaches the long-armed apes, although it is more lively and playful. The colour is greenish yellow above, arising from the hairs being arranged according to different shades of yellow and black; but the colour is more of a dark grizzled appearance on the sides of the body and on the sides of the limbs, which becomes gradually darker towards the hands. The face, ears, and naked part of the hands, are of a jet-black; the former is of a triangular shape, bounded above the eyes by a straight line of stiff black hairs, and on the sides by spreading tufts of light hairs, with a yellowish tinge, meeting in a point beneath the chin. The neck and chest and the under parts of the body have a yellowish tinge, and the inside of the limbs is greyish in colour. The length of the head and body is about from sixteen to eighteen inches, while that of the tail is somewhat more. One of the most peculiar of the monkey class is the genus termed the Proboscis monkey (*Nasalis larvatus* of Geoffroy), which is dis-